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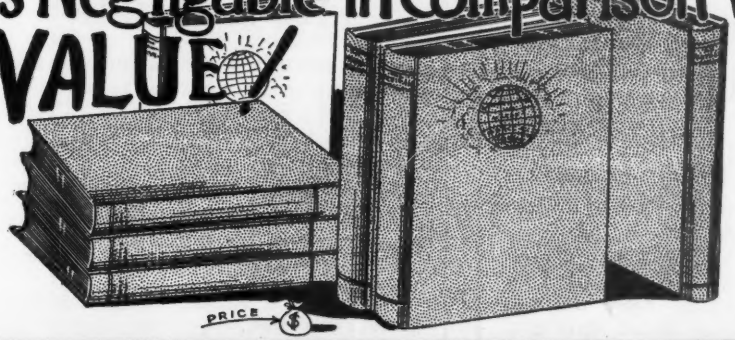

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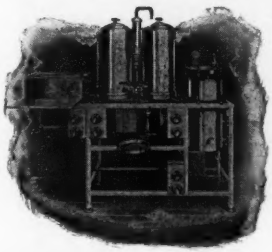

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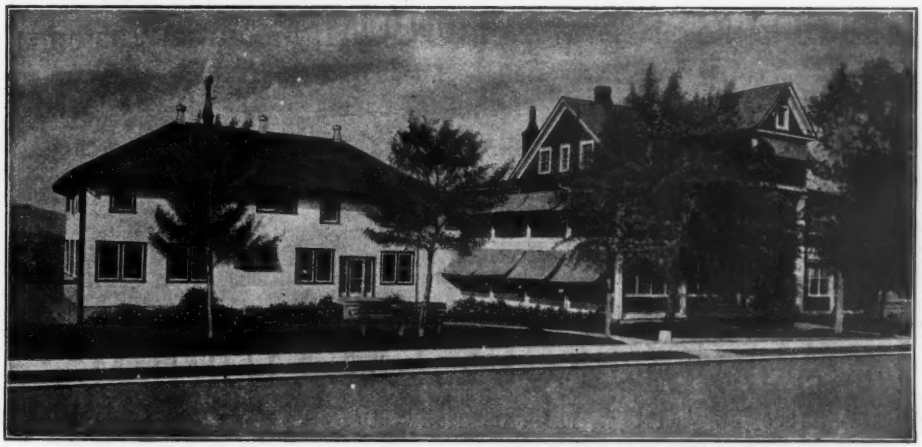

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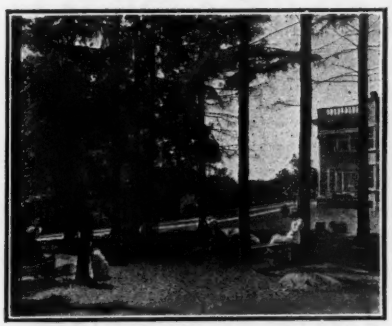

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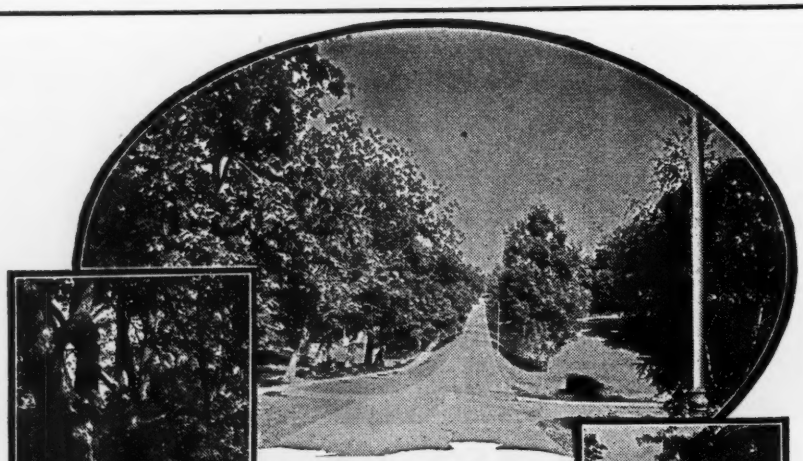

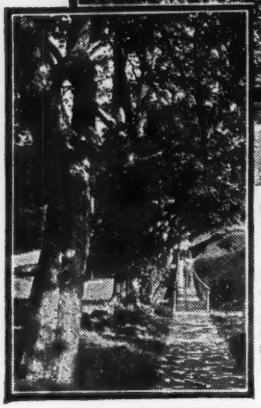

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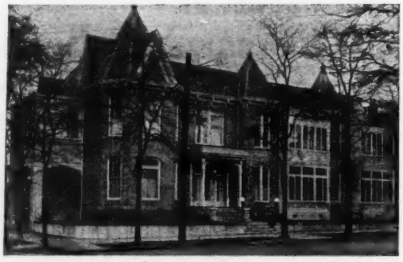

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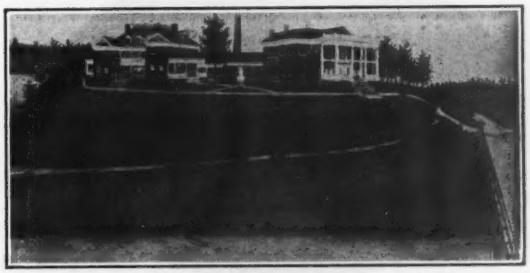

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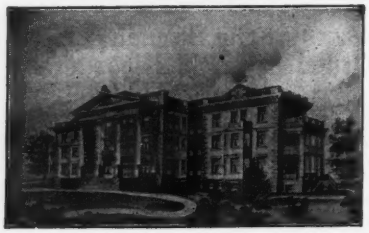

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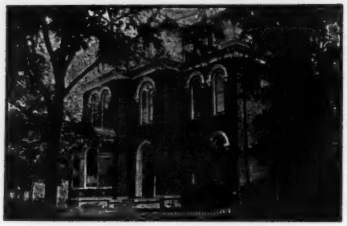

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Volume XVII AUGUST 1924 Number 8

MEDICINE

INTERNAL DISEASES, PEDIATRICS, NEUROLOGY, DIAGNOSTIC METHODS, ETC.

STUDIES OF THE PANCREATIC ENZYMES IN FASTING DUODENAL CONTENTS*†

By DANIEL N. SILVERMAN, M.D.,
and
WILLY DENIS, PH.D.,
New Orleans, La.

The nearest approach to an accurate estimation of the external pancreatic function in man is obtained by analyses of the duodenal fluid. An occasional modern worker in the duodenal field, such as Grote, still believes that this procedure is unreliable and therefore recommends the older and more familiar method of the test meal followed by examination of the stool. However, the fact now remains proven that undigested food has little significance in a diagnostic survey of pancreatic digestion. The use of stools for enzyme determination is also inconclusive. Lipase is destroyed entirely in the intestinal canal while trypsin is somewhat disintegrated. The extensive experimental investigations of Isaac-Krieger have shown the disintegrating powers of intestinal bacteria, and this bacterial action has not been possible of exclusion from the tests. In addition, there is some resorption and adsorption of trypsin in the intestinal tract.

In the summer of 1921 we began work on a systematic study of the measurement of enzymatic activity of duodenal contents from normal and pathological individuals. After the subject had fasted for fifteen hours, fractional specimens of fluid were obtained from the second portion of the duodenum, the location of the tube being verified by fluoroscopy.

Following the trial of several, but by no means all, of the methods which have been described for the chemical examinations of duodenal contents we adopted, with slight modifications, the procedure of McClure and Reynolds. Their method appeared to us best suited to our needs, in that it largely utilized the micro-methods used in the analysis of blood, methods which are familiar to every worker in pathological chemistry, and for the pursuance of which apparatus and solutions are to be found in most clinical laboratories.

These methods consist essentially in measuring the hydrolysis products of fat, starch and casein, the digestion being allowed to proceed in media buffered with phosphate mixtures. As substrate these investigators recommend cotton seed oil emulsified by means of an "emulsifier" such as is used in ice cream manufacture, soluble casein and soluble starch. Our determinations of lipase have all been made on a preparation of emulsified oil obtained from the Walker Gordon Company of Boston, through the kindness of Dr. McClure. In our earlier work we used "soluble casein" prepared according to the

*From the Department of Medicine and the Laboratory of Physiological Chemistry, School of Medicine, Tulane University.

†Read in Section on Medicine, Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

method of Bosworth, but as we soon found that an ordinary preparation of casein (Kahlbaum's "Nach Hammerstein's") gave identical results, we have employed the latter preparation in all our later work.

Soluble starch is such an indefinite product and is apt to contain such large traces of reducing bodies that we have abandoned its use and have made our determinations of amylase by means of corn starch, the solution of which was heated in a boiling water bath for one hour before use. Hydrogen-ion concentration was determined colorimetrically, using the Clark-Lubs series of indicators.

TABLE I

ENZYMATIC ACTIVITY OF FASTING DUODENAL CONTENTS IN NORMAL MEN

Subject	Reaction p_H	Lipolytic	Amylolytic	Proteolytic
1	7.6	1.1 mil	2.6 mg.	2.6 mg.
2	7.0	1.0 mil	2.0 mg.	2.3 mg.
3	7.6	0.8 mil	1.3 mg.	2.9 mg.
4	7.2	2.0 mil	2.1 mg.	2.3 mg.
5	7.4	1.2 mil	1.5 mg.	2.0 mg.
6	7.4	1.1 mil	1.9 mg.	1.9 mg.
7	7.2	1.8 mil	2.0 mg.	1.3 mg.

The above observations on normal men (Table I) show that the average activity of each of the three enzymes is, for lipase 1.3 mils, amylase 1.9 milligrams and protease 1.3 milligrams. The minimum figures for each of the enzymes is: lipase 0.8 mils, amylase 1.3 milligrams, and protease 1.3 milligrams. These quantities are derived from analyses of the duodenal fluids that were neutral or alkaline (p_H 7.0 or less). All specimens registering a greater H-ion concentration than 7.0 were found to have less ferment activity than the maximum for that particular individual, normal or pathological. This fact is illustrated in Table V. The latter shows that even a slightly acid reaction, p_H 6.6, will be accompanied by a somewhat diminished activity of the contents, while p_H 6 is sufficiently acid to inhibit enzyme activity. We, therefore, believe that the action of the ferments depends to a large degree on the hydrion concentration of the duodenal juice. However, reaction alone cannot be depended upon unless one is positive of the position of the tube. It has been our experience to obtain from the stomach fluid having the physical characteristics of duodenal fluid even to the extent of possessing an alkaline reaction. Such a specimen gave much less enzyme activity than the contents from the duodenum of the same subject.

TABLE II

ENZYMATIC ACTIVITY OF FASTING DUODENAL CONTENTS IN CHRONIC BILIARY DISEASE

No.	Reaction p_H	Lipolytic	Amylolytic	Proteolytic	Diagnosis
1	7.6	0.3 mil	1.9 mg.	1.6 mg.	Chronic cholecystitis
2	7.4	0.6 mil	1.0 mg.	1.1 mg.	Chronic cholecystitis
3	7.4	0.5 mil	1.1 mg.	2.0 mg.	Chronic cholecystitis
4	8.0	0.4 mil	1.1 mg.	1.8 mg.	Chronic cholecystitis (operated)
5	8.0	0.0 mil	2.5 mg.	3.5 mg.	Chronic cholecystitis
6	7.2	0.0 mil	2.0 mg.	1.7 mg.	Chronic cholecystitis
7	8.0	0.5 mil	1.2 mg.	1.6 mg.	Chronic cholecystitis (operated)
8	7.2	0.2 mil	1.6 mg.	1.1 mg.	Chronic cholecystitis
Control	7.0	0.8 mil	1.3 mg.	1.3 mg.	Minimum in normal men

In cases of chronic cholecystitis, 85 to 90 per cent of which have been stated to have involvement of the liver (MacCarthy) and 33 per cent of which have been reported to have some infection of the pancreas (Judd, Deaver and Pfeiffer), we found that there was an invariable diminution or absence of lipolytic activity. The lipase or fat-splitting enzyme is unstable and is easily inhibited where there is some pathology in the biliary tract. The amylase and the protease may be diminished to a small degree in a few instances.

TABLE III

ENZYMATIC ACTIVITY OF FASTING DUODENAL CONTENTS IN A GROUP OF MISCELLANEOUS CASES

No.	Reaction p_H	Lipolytic	Amylolytic	Proteolytic	Diagnosis
1	8.0	0.7 mil	2.5 mg.	1.2 mg.	Achylia gastrica
2	8.2	1.0 mil	1.6 mg.	1.7 mg.	Chronic gastritis
3	7.4	0.6 mil	2.0 mg.	1.5 mg.	Enterocolitis
4	7.0	2.5 mil	1.0 mg.	3.6 mg.	Ureteral calculus
5	7.0	1.0 mil	1.2 mg.	1.4 mg.	Neurosis
Control	7.0	0.8 mil	1.3 gm.	1.3 gm.	Minimum in normal men

The small number of miscellaneous cases, including achylia gastrica, enterocolitis and ureteral calculus, gave practically normal enzymatic activities. In the cases of achylia gastrica of unknown origin and of enterocolitis there was a diminution of the lipase to the very slight extent of 0.1 and 0.2 mils, respectively. The protease in the patient with achylia gastrica was 0.1 milligram below the mini-

mum normal. In an instance of ureteral calculus with hyperacidity, amylolytic activity was reduced 0.3 milligrams below the minimum normal. The other enzymes in this case were hyperactive, being greater than the maximum in our normal subjects.

TABLE IV

ENZYMATIC ACTIVITY OF FASTING DUODENAL CONTENTS IN CHRONIC PANCREATIC DISEASE

No.	Reaction p_H	Lipolytic	Amylolytic	Proteolytic	Diagnosis
1.....	7.0	0.8 mil	0.0 mg.	1.6 mg.	Chronic pancreatitis
2.....	7.4	0.3 mil	1.8 mg.	0.5 mg.	Chronic pancreatitis (fatty diarrhea)
3.....	7.2	0.5 mil	0.6 mg.	0.9 mg.	Tropical sprue
4.....	7.0	0.1 mil	1.6 mg.	1.0 mg.	Creatorrhea fol'w'g cholecystecto'y
5.....	7.6	0.5 mil	1.7 mg.	1.0 mg.	Creatorrhea fol'w'g cholecystecto'y
6.....	8.4	0.5 mil	0.0 mg.	0.2 mg.	Hypopancreatism associated with canc'r of gall bladder and liver
7.....	8.4	0.4 mil	0.8 mg.	1.5 mg.	Chronic pancreatitis Chronic hepatitis
Control	7.0	0.8 mil	1.3 mg.	1.3 mg.	Minimum in normal men

TABLE V

THE EFFECT OF REACTION ON ENZYMATIC ACTIVITY OF FASTING DUODENAL CONTENTS

No.		Reaction p_H	Lipolytic	Amylolytic	Proteolytic	Diagnosis
1	a	7.0	1.0 mil	2.0 mg.	2.3 mg.	
	b	6.2	0.0 mil	0.0 mg.	0.0 mg.	Normal man
	c	5.8	0.0 mil	0.0 mg.	0.0 mg	
2	a	5.4	0.0 mil	0.0 mg.	0.0 mg.	
	b	7.6	0.8 mil	1.3 mg.	2.9 mg.	Normal man
	c	5.2	0.0 mil	0.0 mg.	0.0 mg.	
3	a	7.0	0.3 mil	1.1 mg.	2 0 mg.	
	b	7.8	0.2 mil	1.1 mg.	2.1 mg.	Chronic
	c	7.4	0.2 mil	1.1 mg.	1.9 mg.	cholecystitis
4	a	7.4	1.1 mil	1.9 mg.	1.9 mg	
	b	6.6	0.8 mil	1.3 mg.	1.6 mg.	Normal man

In our investigations of clinical or pathologically proven cases of pancreatic disease, it was found that there is at least a diminution of two of the enzymes, with a marked drop in the activity of one of them. In severe dysfunction, as in tropical sprue or hypopancreatism associated with extensive carcinoma of the liver, there may be considerable impairment of the activity of all three ferments.

Only in cases of pancreatic disturbance was it found that the starch-splitting enzyme, amylase, was appreciably affected. In two of such cases this particular ferment was inactive, if present.

SUMMARY

In summarizing our investigations on the external secretion of the pancreas, from analyses of fasting duodenal contents by the method of McClure, the following are our results in a series of normal and pathological individuals:

(1) Normal men give:

(a) Minimum enzyme activity of lipase 0.8 mils, amylase 1.3 milligrams, protease 1.3 milligrams.

(b) Maximum enzyme activity of lipase 2.0 mils, amylase 2.6 milligrams, protease 2.9 milligrams.

(2) Cases of chronic biliary tract disease give:

(a) Minimum enzyme activity of lipase 0.0 mils, amylase 1.0 milligrams, protease 1.1 milligrams.

(b) Maximum enzyme activity of lipase 0.6 mils, amylase 2.5 milligrams, protease 3.5 milligrams.

(3) Cases of chronic pancreatic disease give:

(a) Minimum enzyme activity of lipase 0.1 mils, amylase 0.0 milligrams, protease 0.2 milligrams.

(b) Maximum enzyme activity of lipase 0.8 mils, amylase 1.8 milligrams, protease 1.6 milligrams.

We wish to acknowledge our thanks to Drs. Samuel and Bowie and also to Dr. Henriques for their kind cooperation in performing the fluoroscopic examinations which were essential to our studies.

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DISCUSSION

Dr. S. K. Simon, New Orleans, La.—In the midst of the feast of reason on the subject of the internal secretion of the pancreas, I think it is well that this paper followed to show that the pancreas also has an external secretion which serves a very useful function.

Dr. Silverman's studies had their chief value, I think, in an attempt to standardize the various enzyme functions of the pancreatic secretion. So

far as I know, outside of the laboratory work of McClure and Wetmore in Boston, very little of this work has been done in this country. Dr. Silverman has been working industriously in this field for several years and I think that he has arrived at a very composite index of the means of measuring the real functional activity of the three enzymes of the pancreatic juices. There is no need to stress the importance from a clinical standpoint of the means of determining the presence or absence of the various enzymes of the pancreatic juices. Clinicians have always felt that need. In the past attempts have been made to estimate the percentage of pancreatic enzymes in the feces by studying the feces. This method is attended with extraordinary difficulties and has proven unsuccessful in the hands of most men. A notable exception has been the work in the hands of Dr. Brown, of Baltimore, but he acknowledges that the method is attended with great difficulties and has to be controlled with great accuracy.

In many clinical conditions it is of the utmost value to estimate the presence or absence of each of the pancreatic enzymes. That has come out with particular force in our clinical experience with several cases of sprue which we have handled within the past year. In two of those cases Dr. Silverman kindly assisted in determining whether the pancreatic secretion was diminished in sprue or not, and it was only because of the technic that had been developed in examining the pancreatic juices, by means of the duodenal tube, that we were able to determine that sprue was not actually a disease of the pancreas, but had an entirely different etiology. In many cases of indeterminate diarrhea we have found that there is a definite pancreatic achylia present which confines itself at times to one pancreatic enzyme, usually the amylolytic, and that knowledge serves a most useful clinical purpose.

Dr. T. R. Brown, Baltimore, Md.—We have studied very carefully variations in pancreatic secretion by quantitative estimation of the ferments in the stool, and we believe that if the technic is carried out with rigorous care, there is a very definite low normal, and that we can definitely determine whether or not pancreatic secretions are within normal limits, diminished, or absent.

The work of Dr. Silverman and Dr. McClure in the study of these enzymes in the duodenal contents is very interesting, and seems to show that there is a qualitative as well as a quantitative response to foods. One might say as a result of these various investigations that if the technic is correct, one can very definitely establish a minimal normal both for stool and duodenal contents, below which we can say there is something pathologic present. In very severe cases of sprue and of carcinoma of the head of the pancreas there is practically an absence of ferments. In cases of chronic disease of the gall bladder and in wasting diseases there is, as a general rule, a diminution but not an absence of ferments. In certain cases where you would expect a diminution of ferments, in diabetes and pernicious anemia, there is usually a perfectly normal secretion.

Dr. Silverman (closing).—Dr. McClure is the father of the method which we are using. We do not altogether agree with what he has to say. He believes that by the giving of a definite meal, this meal consisting of 50 mils of 20 per cent cream, and the examination of the duodenal content, he gets a quantitative amount of pancreatic secretion which he believes that he has standardized. We are not certain of what the fasting duodenal contents will do, but we do believe that acid secretion in the duodenum inhibits the pancreatic digestion, and that Dr. McClure paid little attention to this as a reason why he got diminished activity or lack of activity. Perhaps we can standardize the fasting duodenal contents and thereby make comparisons with normal individuals. However, in doing this we have to take a greater number of normal individuals than we have taken in this report. If the fasting duodenal contents can be standardized in normal individuals and comparisons made with pathologic ones we have gone a step forward. We know that if we introduce the duodenal tube and examine the fasting contents there will be no interference with the various other examinations of the fluid. Once you introduce food into the stomach, it interferes with your microscopic and color picture.

THE BACTERIOLOGY OF DIARRHEA IN INFANTS*†

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(I) Etiological classification of intestinal disorders in infants.
  (A) Diarrhea of known etiology (bacillary dysentery, amebic dysentery).
  (B) Diarrhea of unknown etiology.

(II) Theories in regard to the cause of diarrhea.
  (A) Bacteriological data.
    (1) Stool cultures.
    (2) Absence of pathological evidence of primary bacterial infection.
    (3) Fermentative and putrefactive flora.
    (4) Presence of Bacillus acidophilus.
    (5) Duodenal bacteriology.
  (B) Physiological data.
    (1) Increase in undigested and unabsorbed food material in diarrheal stools.
    (2) Changes in the reaction of the gastric juice.

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(3) Changes in the amount of duodenal enzymes.
(4) Role of external heat in producing changes in digestion.
(5) Clinical evidence of a derangement in carbohydrate metabolism.
(6) Possible explanation of efficacy of high protein and acid diets in diarrhea.

(III) Conclusion.

ETIOLOGICAL CLASSIFICATION OF NUTRITIONAL DISORDERS IN INFANTS

As a result of the bacteriological work of Duval and Bassett[1] and of the Rockefeller Commission[2] in 1902 and 1904, acute infantile diarrhea may be divided into two main groups, those of known etiology and those of unknown etiology. The first group contains only bacillary dysentery, while the second is made up of all other instances of diarrhea. Prior to these investigations, the terms cholera infantum, summer diarrhea, infectious diarrhea, fermentative diarrhea, colitis and ileocolitis obscured the subject.

(A) *Diarrhea of Known Etiology.*

Bacillary dysentery is a readily recognized clinical entity.[3] The onset is usually sudden, with anorexia, fever, vomiting, convulsions and irritability or drowsiness. A few hours later the number of stools is increased. These are merely loose at first, but within two days contain blood and by the third or fourth day may be as frequent as thirty per day and consist almost entirely of blood, pus and mucus. In about 20 per cent of the cases, the symptoms increase in severity and the patient dies before the twelfth day. In the remaining 80 per cent the temperature falls to normal by the eighth day, the bowel movements become less frequent, the appetite returns, and during the second week blood disappears from the stools. Convalescence in children over the age of two years is usually rapid, but in younger infants it may be prolonged. Ten per cent of the patients die during convalescence as a result of nutritional disturbances or complications such as pneumonia, making a total mortality of 30 per cent. If the stools of patients with these symptoms are cultured within one or two hours after they have been passed, dysentery bacilli can be isolated in nearly 80 per cent of the cases.[3] These bacilli are usually of the Flexner mannite - fermenting variety.[4] Less than 10 per cent of the cases are due to Shiga infection. If the blood serum is examined by a standard technic[3] eight days or more after the onset of the disease, dysentery agglutinins can usually be demonstrated. Numerous bacteriological and serological examinations of the feces and blood of normal infants have failed to demonstrate dysentery bacilli or agglutinins. There can be no doubt that "bloody or purulent diarrhea" is caused by an infection with dysentery bacilli. There are, of course, a few atypical cases of bacillary dysentery, but they are extremely rare. In addition, amebic dysentery can be occasionally mistaken for bacillary dysentery. However, amebic dysentery is rather uncommon in infants in this country.[5] Furthermore, its chronicity and its absence of striking febrile and systemic reactions facilitate a differential clinical diagnosis. In fact, the clinical features of bacillary dysentery in infants are so characteristic that laboratory assistance is rarely necessary for a diagnosis. As far as can be determined at present, bacillary dysentery is the only group of infantile diarrhea in which bacteria play a definite primary role.

(B) *Diarrhea of Unknown Etiology.*

This group consists of all instances of acute diarrhea except bacillary and amebic dysentery. It is a very indefinite class. Simple diarrhea, fermentative diarrhea, acute intestinal indigestion, fat and carbohydrate intolerance are some of the names applied to this group or to some variation of it. It is possible that further studies may demonstrate definite subgroups, but at present the etiology is unknown, so I shall use the term *diarrhea* for the entire group. Clinically the condition is ill-defined. The usual history is that after a varying period of improper feeding, the patient's stools have gradually become more and more loose and watery. The stools often contain mucus, but no pus or macroscopic blood unless excoriation of the buttocks, a rectal prolapse, polyps or an anal fissure is present. The onset of diarrhea is not necessarily accompanied by fever. Later in the disease the tempera-

ture may become elevated as a result of inanition and dehydration.

Although the etiology of diarrhea has not been proven, several theories have been presented. The advocates of these theories may be divided into two groups: first, those who maintain that diarrhea is due primarily to a bacterial infection of some portion of the intestinal tract, and second, those who believe that the underlying condition is some metabolic or physiological derangement so that the intestines contain a large amount of undigested and unabsorbed food which is split by stool organisms into irritating end products. In other words, both schools believe that bacteria play an important part in diarrhea, but they differ as to whether the organisms are the primary or the secondary cause of the condition.

THEORIES IN REGARD TO THE CAUSE OF DIARRHEA

(A) *Bacteriological Data.*

(1) Stool Cultures.—Practically every organism that occurs in cultures of the stools of infants has been proclaimed as the cause of diarrhea. However, all of these bacteria have failed to satisfy the requirements of an etiological agent, namely, that in addition to being found in the stools of a majority of the patients suffering from diarrhea, they should be absent from the stools of a majority of normal infants. The investigators who reported that these various organisms caused diarrhea neglected to culture the stools of normal control children.

Escherich[6] and others[7] suggested that colon bacilli of exalted virulence produced diarrhea. All of the bacteriological work that has been done has failed to demonstrate any difference between the Bacillus coli occurring in the intestinal tracts of infants suffering from diarrhea and of those who are normal, so it is improbable that colon bacilli are primary etiological factors. Booker and others[8] claimed that infection with Bacillus proteus was the cause of diarrhea. However, proteus bacilli occur too frequently in the stools of normal children to be regarded as the cause of diarrhea. Bacillus welchii, or the gas bacillus, was the next suggestion.[9] This organism was also discarded as soon as the feces of normal control children were examined. It is exceptional not to find gas bacilli, even in large numbers, in normal excreta.[10] [11] In England, Morgan found the bacillus that bears his name in the stools of many patients suffering from diarrhea.[12] Later, extended bacteriological studies[13] in several English cities confirmed this report. However, the absence of agglutinins for the Morgan bacillus in the sera of these patients,[14] and the frequent occurrence of this organism in normal stools, tend to disprove any relationship to diarrhea. Bacillus pyocyaneus[15] and Streptococcus fecalis[16] have been discarded as causes of diarrhea for similar reasons.

(2) Absence of Pathological Evidence of Bacterial Infection.—In intestinal diseases of known bacterial origin, such as bacillary dysentery and typhoid fever, there is anatomic evidence of the action of these organisms or their toxins. On the other hand, in the intestines of patients dying with the symptoms of acute or prolonged diarrhea, there may be no pathologic lesions. The mucosa may, perhaps, be slightly hyperemic or the intestinal wall may be thinned, but these features are probably the result of increased peristalsis, distention and emaciation. If diarrhea were due to the absorption of bacterial toxins from the intestines or to a bacterial infection at any point along the intestinal tract, it is likely that there would be some demonstrable lesion such as pseudomembrane formation or ulceration.

(3) Fermentative and Putrefactive Flora.—Since all of the organisms so far found in the stools of infants suffering from diarrhea, are, individually, harmless saprophytes, some investigators[17] [18] [19] have suggested that various combinations of these bacteria might be responsible for intestinal disorders. If proteolytic organisms predominated, the patient was said to be suffering from the effects of a putrefactive flora. If the organisms were largely saccharolytic, a fermentative flora was described as the causative agent. Our studies[11] have demonstrated that the so-called putrefactive and fermentative intestinal flora frequently exist in normal

children without causing the slightest symptom of a nutritional disorder.

As a matter of fact, Bacillus coli is the predominating organism in practically all stool cultures. This bacillus is facultatively putrefactive and fermentative. If grown in protein mixtures such as peptone water, it "putrefies" by producing indol, skatol and alkali. If grown in carbohydrate media, Bacillus coli causes "fermentation" with acid and gas. For that reason it would appear inaccurate to speak of a "putrefactive" or a "fermentative" flora. It is more probable that intestinal putrefaction and fermentation depend upon the medium furnished by the diet rather than on a separate stool flora.

(4) Presence of Bacillus Acidophilus.—Recently it has been reported that nutritional disturbances in adults, children and rats might be associated with the absence of Bacillus acidophilus from the intestinal flora.[20] The condition, according to this view, is due to a deficiency of normal organisms rather than to the presence of abnormal ones. This is a new conception in bacteriology. In an endeavor to confirm this work we have made some studies which are not yet complete. In practically all of the stools of a large number of infants and children who were suffering from diarrhea, we have found[11] Bacillus acidophilus to be as numerous as it is in the stools of normal children. We[21] have also fed acidophilus milk to three infants convalescing from nutritional disturbances and studied its effect on the stool flora and clinical condition. The numbers of Bacillus acidophilus in the stools of these infants became greatly increased, and the numbers of Bacillus coli were somewhat diminished. However, two of these three infants developed diarrhea. Although these cases are too few from which to draw conclusions, it appears to us that Bacillus acidophilus can have little, if any, relation to infantile diarrhea.

(5) Duodenal Infection.—One of the most interesting chapters in the study of diarrhea is the bacteriology of the duodenum. Few organisms can be cultivated either ante or post mortem from the duodenal contents of infants without diarrhea.[6 19 22 23 24] On the other hand, the duodenal contents of infants suffering from or dying of diarrhea have the typical stool flora.[18 19 22 24] The facts themselves are indisputable, but their interpretation is open to question. It is impossible to state at present whether this implantation of bacteria in the duodenum is the cause or the result of diarrhea. Is the diarrhea produced by a primary duodenal "infection" or do the organisms invade this area as a result of the reverse peristalsis and lack of tone that accompanies diarrhea; or has some primary derangement of digestion or absorption allowed food material to accumulate in the duodenum and thus to furnish a culture medium in which bacteria may multiply? The fact that cow's milk and the other articles of the ordinary diets of normal infants are far from sterile and yet do not cause duodenal infections suggests that a duodenal infection is not a primary condition. Other factors probably must supervene in order that the bacteria may gain a foothold. Those who believe that diarrhea is the result of a duodenal infection ascribe the benefits derived from diets of protein milk or lactic acid milk to their antiseptic action. In test tubes, these milks can kill Bacillus coli and Bacillus dysenteriae within two hours.[24] It has been found[25 26] that, although the duodenal contents of diarrheal patients are heavily infected yet one-half hour after the feeding of lactic acid milk, the cultures are sterile. These results by no means demonstrate that the primary cause of the diarrhea is a duodenal infection, although some of the benefits of lactic acid milk may be due to its antiseptic action. The benefit of this antiseptic is as likely to be derived from the inhibition of the fermentation of undigested or unabsorbed carbohydrate by the stool organisms as from the "curing" of a duodenal infection.

As a matter of fact, those who have done most of the work on enteral or duodenal infections[19 22] report that almost every nutritional disturbance leads to a great change in the contents of the duodenum and small intestine. There is stagnation and the upper intestinal contents become more fluid in character, richer in food material and hence an excellent culture medium. In other words, some primary physiological derangement

has supervened and produced favorable conditions for bacteria to ascend into the duodenum from the colon and to increase in numbers. It is suggested[19] but not proved that these organisms may increase in virulence. It may be that the fermentation produced by these bacteria in the duodenum is a more important factor in producing the symptoms of diarrhea than the fermentation that occurs if undigested food reaches the colon, but apparently the primary factor is the physiological derangement that makes excessive fermentation in either area possible.

(B) *Physiological Data.*

The data available at present renders it unlikely that diarrhea is caused by a primary bacterial infection. On the other hand, there is some evidence that suggests a primary derangement of digestion and absorption.

(1) Increase in Undigested and Unabsorbed Food Material in Diarrheal Stools. The protein and fat content of loose diarrheal stools has been found[27] to be from two to three times that of normal stools. It is impossible, however, to state at present whether this decrease in digestion and absorption is due to a primary physiological derangement or merely to the rapid progress of the food through the intestines which results from increased peristalsis.

(2) Changes in the Reaction of the Gastric Juice.—Marriott[28] has demonstrated changes in the reaction of the gastric juice of infants suffering from diarrhea. The average hydrogen ion concentration of the gastric contents of a normal breast-fed infant is p_H 3.6 (the maximum being attained in 1½ hours after feeding and continuing thus for one hour). The p_H of the gastric contents of a child with nutritional disturbances, fed on woman's milk, is 5.1 and on cow's milk 5.4. It is conceivable that this reduction in gastric acidity may be one of the primary underlying causes of diarrhea. As a consequence, the action of pepsin and other gastric enzymes may be so impaired that undigested food accumulates in the intestines, and furnishes favorable conditions for the colon flora to ascend into the duodenum and to produce excess fermentation. The loss of duodenal antisepsis which results from a lowered gastric acidity may also be a factor in allowing organisms to invade this area.

Since the p_H of the gastric contents of a normal infant fed on whole cow's milk is 5.1, diarrhea can arise more easily on a cow's milk diet than on woman's milk. Cow's milk requires three times more acid than woman's milk to produce the same acidity. The addition of 30 c. c. of tenth normal hydrochloric acid changes the p_H of whole cow's milk from 6.7 to 5.9 and of woman's milk from p_H 6.8 to 3.4. One-third cow's milk, lactic acid milk and woman's milk have approximately the same rate of change of p_H when hydrochloric acid is added.[28] The improvement of diarrhea after diets of diluted cow's milk and lactic acid milk may be explained as a result of the return of the gastric p_H to normal. Infants are said to thrive better and to retain inorganic and organic material better on lactic acid milk than on cow's milk. These changes in gastric acidity and the difference in buffer value of cow's and woman's milk are probably important factors in the etiology and treatment of diarrhea.

(3) Changes in the Amount of Duodenal Enzymes.—In a quantitative study of the enzymes of the duodenal contents of twenty infants suffering from severe diarrhea I[24] have found that the starch and protein splitting enzymes are apparently reduced. This reduction may explain the increase in undigested and unabsorbed food in diarrheal stools.

(4) Role of External Heat in Producing Changes in Digestion.—It has been known for centuries that infantile diarrhea is more common during the summer months. Many experiments have been made to ascertain whether there is any causal relation between external heat and diarrhea.[29] Beaumont,[30] in 1833, demonstrated that during fever the amount of gastric juice secreted by Alexis St. Martin was diminished and that digestion was delayed. Loss of appetite during hot weather is a common observation even in adults. The gastric secretion is depressed in dogs exposed to sufficiently high external heat to raise their body temperature 2 to 4 degrees Fahrenheit.[31] Wolff[32] re-

ported the case of an infant who developed diarrhea within a few hours after being overheated by hot water bottles. Normally, even excessive summer heat does not appreciably raise the body temperatures of properly clothed babies, but it is possible that in those who are too heavily dressed, the body temperature may become elevated. McClure and Sauer[33] have shown the influence of clothing in increasing body temperature, for they noted that the temperatures of puppies who wore jackets became elevated when they were kept in an incubator heated to 40 to 44 degrees Centigrade and that they died in two to four days, while the body temperature of unclothed puppies remained normal at excessive external temperatures.

The changes in gastric secretion during elevations of body temperature may be due to the amount of fluid lost through perspiration and the lungs and the consequent concentration of the blood; to the personal discomfort produced by the heat, for discomfort alone can reduce gastric secretion,[34] or to the elaboration of toxins having a direct depressor action on the stomach cells.[31]

Gastric analyses in adults have demonstrated that the amount of residual gastric content is usually greater during the summer.[34] This increase may be due to changes in gastric motility or tonicity induced by heat. Hamburger[35] states that delayed emptying time of the stomach is the first feature of diarrhea.

It is reported[19] that large numbers of bacteria can be demonstrated in the small intestines of dogs and rabbits who have been fed excessive amounts of sugar and subjected to high external temperatures. The heat apparently paralyzed the normal functions of the small intestine and the sugar furnished an excellent culture medium.

(5) Clinical Evidence of a Derangement in Carbohydrate Metabolism.—The majority of infantile diarrheal stools are acid in reaction. Most cases of diarrhea are aggravated by increasing the carbohydrate intake and can usually be cured by restricting it. Therefore, it would seem reasonable to suppose that many instances of diarrhea might primarily be due to a failure on the part of the small intestine to digest or absorb carbohydrate.

That the products of the "fermentation" of unabsorbed carbohydrate may be the cause of diarrhea would seem to be indicated by the fact that children who have numerous loose stools when given carbohydrate in the form of cane sugar or lactose may not have diarrhea when fed polysaccharides, such as farina. It is probable that dextrose and maltose are liberated gradually from the slowly digesting cereal and starch. The absorptive power of the small intestine, even though diminished, may keep pace with these small amounts of free dextrose and maltose and thus prevent their fermentation. Cane sugar or lactose in excess of the amounts that can be absorbed, even in normal individuals, will frequently produce loose stools. The "fermentation" of unabsorbed carbohydrate and the consequent gas production undoubtedly play a part in abdominal distention, for restricting the intake of sugar frequently relieves distention.

It is also conceivable that there may be instances of intestinal disturbances in which protein digestion and assimilation are delayed. The colon bacilli of the intestinal flora would then "putrefy" the unabsorbed protein into proteinogenous amins and produce foul-smelling stools. It is not at all clear whether these products of "putrefaction" may be absorbed and give rise to a systemic reaction in the absence of any pre-existing injury to the intestinal wall. Schiff[26] believes that these end products of colon bacillus metabolism are responsible for the toxic symptoms of patients suffering from diarrhea.

(6) Possible Explanation of Efficacy of High Protein and Acid Diets in Diarrhea.—In test tubes, the addition of fatty acid esters and of protein to solutions of carbohydrate inoculated with Bacillus coli increases the amount of fermentation as measured by the gas produced after 24 to 96 hours' incubation.[24 26] However, the tubes containing larger amounts of protein (peptone and casein) become alkaline.[24] Perhaps this is the explanation of the efficacy of high protein diets, for the alkali liberated from the splitting of protein may neutralize the fatty acids into

non-irritating products. Perhaps also this explains why infants receiving a diet very high in carbohydrate and low in protein (condensed milk) more frequently have diarrhea during warm weather than infants whose diets contain a larger amount of protein. In test tubes, increasing the acidity decreases the amount of fermentation by Bacillus coli.[26] Possibly the acidity of lactic acid milk accomplishes this same result in the intestinal tract and this explains its efficacy.

CONCLUSIONS

Although there is, as yet, no absolute proof of the etiology, it would seem probable that infantile diarrhea, except bacillary and amebic dysentery, is not a primary bacterial infection, but that, as a result of changes produced by external heat or by some other cause, the gastric acidity and motility and the gastric and duodenal enzymes are reduced. Undigested and unabsorbed food is then fermented by the stool organisms, either in the small or large intestine, into irritating end products which accelerate peristalsis and produce diarrhea.

Experiments on dogs[36] have demonstrated that repeated small doses of some of these end products can accomplish these results. The action of the end products is probably in the nature of a chemical irritation rather than a bacterial inflammation and thus the absence of post mortem lesions may be explained.

Jackson,[37] in 1812, probably came near the truth when he attributed "the chemical changes which take place in the contents of the stomach and bowels of children dying of diarrhea to the putrefaction of animal food and the acetous fermentation of that which is vegetable."

Discussion follows paper of Dr. Spence, page 568.

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EXCITING AND PREDISPOSING CAUSES OF DIARRHEA*

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Since infectious diarrhea differs in intensity and frequency in various sections of our country, I welcome the opportunity of discussing this important subject, especially in a borderline city.

Infectious diarrhea is largely a preventable disease, yet there is very little definite literature on this subject. Holt, in his recent presidential address to the American Pediatric Society, announces among the accomplishments of twenty-five years a reduction of deaths due to diarrheal diseases under five years in New York City from over seven thousand in 1896-97 to less than two thousand in 1921-22. In Tennessee during the past five years, diarrheal deaths under two years have been reduced from 1406 to 738. These results have been accomplished by the education of the profession and laity in proper feeding and hygiene; in other words, by improving the resistance of the child more than by the development of new methods of treatment. Assuming that morbidity follows mortality, not only have these lives been saved, but digestive cripples of adult years have been prevented, as a severe diarrheal infection usually leaves its stain.

The exciting cause of infectious diarrhea is undoubtedly an infection with some pathogenic organism or organisms, and in preventing this, the improved methods of handling milk, the technic of feeding, the "swat the fly" campaign, the widely spread instruction in general cleanliness and hygiene through the public nurses, and, last but not least, the extended use of boiled milk, have been responsible in a great measure for the decrease in the number of infectious contacts.

The predisposing causes of diarrheal disease are: age under two years, the summer season, defective hygiene, eruption of teeth, and improper food.

Age and season are, of course, unpreventable, though a summer spent in a climate where diarrheal diseases are not severe may be advisable in peculiarly susceptible children.

Hygienic errors in our section are almost negligible, as there is little crowded tenement life. Occasionally we see children in the winter too carefully housed, breathing the hot stale air of the apartment, loaded down with heavy clothing, kept in a temperature which, were it only summer, would drive the mothers to the seashore. Such babies are anemic, lack resistance, and fall early prey to diarrheal infections.

Teething should not be accorded a place as a predisposing cause. I mention it because the diagnosis, teething, is responsible for so many deaths. It is true that during an acute teething period digestion is weakened and foods which previously agreed may disagree. Tolerance is lowered, but it is the undigested food, not teething, that causes increased peristalsis. Many mothers think it quite natural that diarrhea should accompany teething and allow it to progress uncared for, whereas, any looseness developing at this period demands even more strenuous efforts to correct it at once. Teething, then, is only a predisposing cause through a lowered tolerance for food.

Food is the great predisposing cause, and the fact that few breast-fed babies have serious infections emphasizes the importance of human milk with its wonderful immunizing and nourishing powers. Every available drop should be used. It is my observation that most of the mothers of our section who can nurse their babies at all can give them at least a partial

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supply up to fifteen months, and while I believe that mixed feeding should be begun as early as nine months, partial breast feeding can safely be extended to fifteen months, especially in hot weather. This should be emphasized, as the time of weaning has been placed by many Northern and Eastern authorities at nine months. Do not rely upon breast feeding entirely after nine months, but if it is possible to retain some breast milk during the summer it may prevent infection. After fifteen months, nursing is usually detrimental. Such babies are nervous, under-nourished, poor sleepers, with capricious appetites, and mothers and babies are both nervous wrecks.

Good milk is necessary in the prevention of diarrheal diseases, and in the presence of one or more of the predisposing causes, it is advisable to boil all milk, even though it is certified. If we regard the essential cause of diarrhea as a food injury to the tender intestinal mucosa, which furnishes a portal of entry for the invading bacteria, the beneficial effect of boiled milk is due as much to the increased digestibility which prevents such injuries as to its sterility. Opportunities for infection are almost omnipresent, and the surest way to maintain resistance is to preserve an uninjured mucosa.

The prevention of diarrhea should be in our minds at all times. Even in the winter a visit to a baby who will be subjected to the predisposing causes next summer should be the occasion of instructions to the mother in the proper method of increasing resistance and avoiding infection.

It behooves us, then, to spread the following axioms:

First, that human milk is the only perfectly safe food, and that every available drop should be used, carefully noting the nutrition of the child. It is best, however, to train the infant early upon some substitute feeding before it is absolutely necessary. Mixed feedings should be begun some time before nine months.

Second, in artificially fed babies, especial attention should be given to the maintenance of a well balanced ration. Babies fed on patent foods, deficient in fats, with an excess of sugar, while apparently thriving and gaining weight, lack resistance to diarrheal infections and fall early victims if attacked.

Third, get the best and freshest milk available, and this, even though certified, must be boiled in the summer. This process not only renders it sterile, but makes the protein more digestible and there is less danger of food injury. This, in the opinion of many, explains the vast improvements in the vital statistics of diarrheal disease rather than the mere fact that boiled milk is sterile.

Fourth, babies need less food in the summer, but more water. In the beginning of hot weather dilute the formula and reduce the fat. Three per cent is the maximum fat limit in the hot season.

Fifth, the appearance in the stools of undigested food, such as milk curds in the summer, is a danger signal not to be neglected and the formula should be reduced and kept low until the stools are normal.

Sixth, do not attempt correction of constipation in young children in the summer with laxative foods. Even though boiled milk may prove constipating and greatly disturb the mothers, it is safer to use some simple laxative than to attempt to correct the constipation by the bacteria content of raw milk.

Seventh, fruits and green vegetables are not permissible in the summer in babies under two years of age, and only with the greatest care in older ones. This statement is the result of observations of many years and should be emphasized because many men high in authority advise the use of green vegetables and raw fruits even to babies of six months of age without reference to seasons. For some time I have felt that this was purely a sectional difference, but it was a great relief to find that Hill and Morse, of Boston, in recent publications, advise that fruits and green vegetables should be given only after two years at any season.

Eighth, diarrheal diseases are progressive. A milk curd, for instance, may act as a mechanical irritant, causing a symptomless increased peristalsis. While in the intestine it may ferment or putrefy with resulting toxic symptoms. Then by

mechanical or chemical irritation there may be an abrasion of the intestinal mucosa, furnishing a portal of entry for the invading germ. In other words, in the vast majority of cases, the severe forms of the disease are preceded by milder, unnoticed mechanical or fermentive stages. This emphasizes the necessity of attention to any diarrheal condition in the presence of predisposing causes. It is a useless waste of time to try to pigeon-hole the case, but treat them all as most serious. The disturbance may be due to protein, to sugar, or to fat, but when one tolerance is exceeded, everything rapidly goes awry. Do not try to classify, but for the first twenty-four hours at least put the child under the most rigorous regime. Then as the case progresses and symptoms are more positive you may be able to relax. It is not safe to assume accurate knowledge at the first visit. Stools may be twenty-four hours late in showing the true character of the pathology.

The keynote is to prevent infectious contacts, but keep up resistance by constructive feeding and hygiene, and avoid food injury. Trust in the Lord, but keep your powder dry.

Discussion follows paper of Dr. Spence, page 568.

TREATMENT OF DIARRHEA*

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Diarrheas following acute intestinal upset, the result of improper diet, or the result of improper diet plus lowered resistance, due to various causes, are not considered in the subject matter of this paper. I shall say merely that the establishment of a correct diet and attention to those conditions causing a low resistance will effect a cure.

In the treatment of diarrhea we are, therefore, considering those infectious types which the majority of us, by now, are beginning to classify as belonging to the dysenteric group.

As prevention takes the position of first importance in any treatment, it is interesting to see the change in death rate from diarrheal diseases in recent years as compared with the time when less was known about hygiene, prevention, etc.

According to Holt,[1] in New York City, while the population has enormously increased in the last 25 years, the death rate from diarrheal diseases fell from 7224 in 1896 and 1897 to 1924 in 1921 and 1922. And diarrhea fell from first to third place in the percentage column as a cause of death. It is reasonable to suppose that the reduction in mortality has not been confined to one locality, but obtains throughout the country, and that preventive medicine is entitled to no small share of credit for the results.

In the treatment of diarrhea, nutrition occupies a very important place. In severe types, on account of the extreme nausea and vomiting, nourishment as well as fluids are often not retained for days, and this in the face of enormous loss of body fluids by the bowel. Both of these conditions serve to increase the toxemia.

By overcoming the life-long delusion that the initial purgative is necessary, and by giving a food that will be digested in the stomach and upper bowel, and repeating this food when it is vomited, the loss of weight will not be so manifest during the early weeks of the disease.

Protein milk is recommended by many as the diet of choice.[2] However, I believe that the majority of Southern men are having better success with carbohydrate feeding. Wheat flour, cooked until it is free of protein and given with plain boiled water, is the best form of carbohydrate available early in the disease. Later on, after the vomiting has been stopped, some form of the sugars may be added.

Boiled water should be given freely and often. If vomiting is persistent and severe, other methods for the introduction of water into the system may be used. These include the Murphy drip by a nasal tube, hypodermoclysis, intraperitoneal injections, and in extreme dehydration, intravenous injections should be used. The point should be stressed that when fluids are indicated by any of these methods they should be used early rather than late, thus avoiding the profound toxemias that

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go with dehydration. There is often a secondary acidosis in these cases, the occurrence of which should be recognized and properly treated.

Complete rest is essential to this class of cases. Foods, medicines, etc., should be so arranged that there will be the least disturbance to the patient. The matter of rest applies particularly to the affected bowel. Turning the patient, the ingestion of cold water or milk brings on a spasm of the bowel with its paroxysm of pain and the passage of blood and mucus. Nothing will afford relief in these cases like opium. Morphin is the drug of choice,[3] given in minute quantities, with bismuth subcarbonate or bicarbonate of soda, or both, and repeated often enough to control the over-active and inflamed bowel, and not enough to cause drying of the secretions or drowsiness, for it will have its effect upon the bowel before it has upon the secretions. Immobilizing an inflamed bowel carries with it the same rationale as splinting a broken arm.

Irrigation of the bowel with various solutions has been recommended, but only in isolated cases has benefit been reported. Topical application to the ulcerated area through a proctoscope has also been used. The majority of physicians, however, are against the use of these measures. Specific serum therapy is coming more into favor as more is known of its use and effect. Polyvalent serum containing both Flexner and Shiga antibodies are available and should be used immediately in severe cases until the type of infection is determined, after which the specific serum should be used. Reports indicate that serum from the Shiga bacillus is more effective than from the Flexner type. Shiga antitoxin has been proven of benefit and is used in the place of serum.

There is much under the treatment of diarrhea that is symptomatic: the sudden elevation of temperature, distention of bowel, convulsions, and many other symptoms not mentioned keep one constantly on guard and place diarrhea in the class of cases with too high a mortality rate.

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Discussion follows paper of Dr. Spence, page 568.

THE THERAPEUTIC VALUE OF THE BACTERIOPHAGE IN TREATMENT OF BACILLARY DYSENTERY*†

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D'Herelle, in 1917, found that the filtrates from broth cultures of stools of convalescent dysentery patients were lytic for or would dissolve the dysentery bacilli. When from two drops to two mils of this substance were added to young broth cultures of Bacillus dysenteriae Shiga, it was found that in a few hours' time the bacilli were lysed and the suspension became clear. If agar slants were inoculated with this clear solution it was found after several hours of incubation that there was either a sterile slant, which d'Herelle called a "pure culture of bacteriophages" or there were multiple minute round clear areas in which no dysentery bacilli would grow. These areas were in turn called "colonies" of bacteriophages. It was further observed that by touching one of these clear areas with a sterile platinum loop, the so-called "lytic substance" or bacteriophage could be transplanted to other young broth cultures of Bacillus dysenteriae Shiga, and this suspension would in turn become clear. Thus the phenomenon could be repeated.

D'Herelle then isolated from the stool of a patient convalescent from dysentery a "substance" which was lytic for or would dissolve dysentery bacilli; and this lytic power increases at the expense of the organisms lysed.

The bacteriophage is a "substance" which is lytic for or has the power to dissolve bacteria. Much work has recently been done in an effort to determine the exact nature of this "substance," and how its destructive action on bacteria is

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brought about. Since this paper deals with the clinical aspects of the bacteriophage, only that part of the literature which has to do with its clinical application will be reviewed.

D'Herelle,[1] in his book on the bacteriophage, reports five cases of clinical dysentery which were treated by the ingestion of a broth suspension of the bacteriophage. All of these cases were of the Bacillus dysenteriae Shiga type and occurred in children varying in age from three and a half to twelve years. Their stools varied in number from five to seven daily in the lowest, while others passed so many that they could not be counted. All these children were cured clinically and were discharged from the hospital in from nine to fourteen days after admission.

Staphylococcus and anthrax infections were successfully treated with the bacteriophage by Brunoghe and Maisin.[2] Their preparation was administered by subcutaneous injections.

Beckerich and Hauduroy[3] report five cases of typhoid fever and two cases of paratyphoid fever treated with the bacteriophage. The preparation was given to three of these cases simultaneously by mouth and subcutaneously. The symptoms in all these cases subsided within forty-eight hours after treatment was started. These authors also reported two atypical cases of typhoid fever treated by this method. These two cases had marked myocardial involvement. Their fever subsided within forty-eight hours after treatment was begun, but both cases terminated fatally. It was suggested that failure was probably due to the fact that treatment was started late in the course of the disease and that the doses given were too small for cases so severe. Two cases of puerperal pyelocystitis due to Bacillus coli were also treated by this method. The temperature in both of these cases became normal within forty-eight hours after they were given subcutaneously 1 mil of anti-Bacillus coli bacteriophage.

In connection with the cases reported by these authors it is interesting to report a case of typhoid fever treated with the bacteriophage by Drs. Winans and McKinley, of Dallas.

A young woman developed a positive Widal on the eighth day after the onset of a typical fever. Starting on the tenth day, the bacteriophage was given in 10 mil doses three times daily by mouth and six minims were given intravenously each day for three days. The patient showed a subjective improvement within twenty-four hours after the treatment was begun. Her appetite became much better and she was much less restless. The fever dropped to normal in three days' time, at which time the supply of the bacteriophage gave out. During the next three days the fever began to rise, going a little higher each day, finally reaching 103 on the sixteenth day after the onset of symptoms. A small quantity of the bacteriophage was then obtained and doses of six minims each were given intravenously for the next five days. During this period the temperature showed a distinct change: it became intermittent in type, rising to 103° for a short time each day. On the twenty-first day after the onset a large supply of the bacteriophage was obtained and the patient was given 40 mils four times daily by mouth. At the end of twenty-four hours her temperature dropped to normal. For the next two days it rose to 100 only and afterwards remained normal. Recovery seemed to date from the day that the large quantities of the bacteriophage were given.

Courcoux[4] reports a case of pyelonephritis in a young woman, the first symptom of which was observed at the sixth month of pregnancy. The bacteriophage was given by subcutaneous injection and by the injection of 15 mils directly into the bladder. There was considerable reaction for forty-eight hours, then all the clinical symptoms subsided. Bacillus coli, however, could still be cultivated from the urine.

Davison[5] reports a series of twelve cases of bacillary dysentery of the Flexner type treated with the bacteriophage. These cases occurred in children whose ages varied from four months to four years. Their mortality was 58 per cent. The author concluded that in this series of cases the bacteriolysant therapy did not influence the mortality or the course of the disease. He states, however, that the failure may possibly be explained on the grounds that the treatment in the majority of these cases was commenced late in the course of the disease. The only two patients treated within the first week after the onset of the disease recovered.

Barbosa[6] treated two women with pyelitis due to a staphylococcus infection by the subcutaneous injection of 0.5 mils and 1 mil of the bacteriophage. The disease

had resisted other measures of treatment for twenty-three and ten days, respectively. The clinical symptoms subsided completely within two days following the injection in the one, and within six hours after the injection in the other. The urine in both cases was soon sterile. A third case with a suppurating wound was treated by the local application of the bacteriophage. Prompt improvement followed.

Da Costa Cruz[7] gave the bacteriophage by mouth in 2 mil doses to twenty-four cases of bacillary dysentery. Marked benefit followed in every case. In some cases the improvement was noted as early as four or five hours after the treatment was begun. In some cases recovery was complete after one or two doses.

One of us (McKinley)[8] treated four cases of chronic suppurating wounds by the local application of the bacteriophage. The infections were due to Staphylococcus aureus and the discharge in each case was profuse. In three cases the infection followed the removal of pieces of bone due to a compound fracture.

The fourth case followed an operation for osteomyelitis. After the first treatments the discharge was much less in amount. After from three to six treatments, respectively, the discharges stopped and the wounds promptly healed.

A case of pyelitis following the removal of a stone from the left kidney was also treated. The Staphylococcus aureus was the infecting organism. After the injections at three-day intervals of four doses of the bacteriophage, in amounts of 8 mils each, the symptoms cleared up promptly. These injections were made directly into the pelvis of the kidney through a ureteral catheter. There was no reaction following the injections.

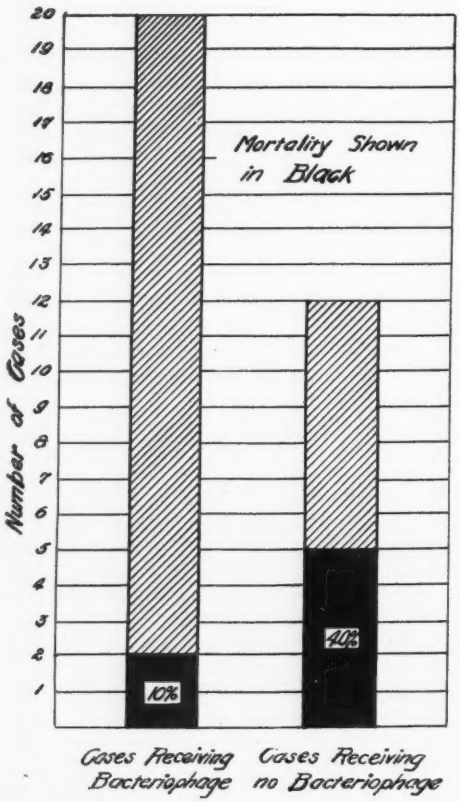
A streptococcus abscess of the lung was treated locally with the bacteriophage. There was a profuse, foul discharge following rib resection and drainage. The odor disappeared after the first injection. The drainage stopped after three treatments over a period of ten days. The wound promptly healed. In this case the bacteriophage was injected with a syringe directly into the chest cavity. There was no marked reaction.

A case of chronic dysentery due to Bacillus dystenteriae Flexner was treated with the bacteriophage. This case was a young woman who gave a history of loose stools with blood and mucus for a period of nine years. After having been given two doses of 30 mils each at weekly intervals through a duodenal tube, the blood and mucus disappeared from the stools. The patient's stools were normal for two months. At that time, however, she began having diarrhea again.

It was concluded, from the treatment of the above cases and others, that the bacteriophage holds enormous potentialities as a new weapon for fighting infectious diseases. In order further to confirm these conclusions we decided to apply this method of treatment to any cases of infectious diarrhea which might come under our observation. Realizing from the cases reported in the literature that the earlier in the course of the disease this type of treatment is begun the greater are the possibilities for beneficial results, and also realizing that in order to draw any definite conclusions some standardized method of treatment should be adopted, we proceeded as follows:

The method of standardizing the bacteriolysant preparation has been described by one of us (McKinley).[8] A bacteriolysant sent by d'Herelle was used for a control in testing the various filtrates. A filtrate from the stool of the first dysentery patient obtained was found to be positive for the bacteriophage. This case was due to Bacillus dysenteriae Flexner. It is included within the control series, since it was not treated with the bacteriophage. The virulence of this bacteriolysant filtrate was increased by the technic described by d'Herelle until sterile agar slant subcultures were obtained. At this point the filtrate, which was about 40 mils in amount, was placed in a large sterile test tube and 1 mil of a twelve-hour broth culture containing two billion dysentery bacilli was added to the filtrate. The filtrate was incubated for twenty-four hours. At the end of twenty-four hours the organisms were lysed and the filtrate was clear. On the second day the process was repeated, using 2 mils of a twelve-hour broth culture of dysentery bacilli. On the third, fourth and fifth days, three, four and five mils of the young broth cultures were used, respectively. We then had a filtrate which had lysed a total of about thirty billion dysentery organisms in six days, ten billion being lysed on the last day.

Since the filtrate had remained clear it was of course unnecessary to filter, but as a precaution the filtrates were filtered and then incubated for twenty-four hours to prove their sterility. The preparation thus



prepared and standardized was divided into doses of 10 mils each and sealed in ampoules ready for use.

It was agreed that all cases should be placed on a protein diet throughout the course of the disease. A specimen of stool was obtained for bacteriological examination at the first visit in the cases which presented the clinical picture of bacillary dysentery. A sufficient quantity of the bacteriophage was left at the same time with the instruction that 10 mil doses be given by mouth three times a day, the first dose to be given at once.

Twenty-six children varying in age from four months to six and a half years were treated in this manner. Dysentery bacilli were isolated from the stool in only twenty of these cases. It was often difficult to get follow-up stools since all of these cases were private patients. In those cases in which a second stool was examined the bacteriophage was found to be present and the stools were negative for the dysentery organisms. Only the proven positive cases are included in this series. Nine of these were due to Bacillus dysenteriae Shiga and eleven cases to Bacillus dysenteriae Flexner.

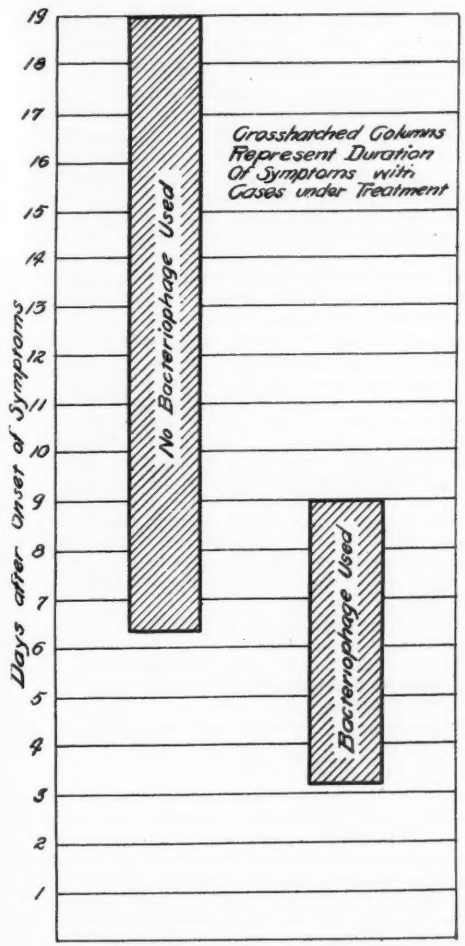
The average period of time elapsing between the onset of symptoms and the beginning of treatment was 3.1 days. In other words, nineteen of the twenty cases were treated within the first week of the disease. The average maximum number of stools, most of which contained blood and mucus, was 20.2 in twenty-four hours. The average maximum temperature was 103.2. In three of these cases the onset was accompanied by convulsions. Of this series of twenty cases treated with the bacteriophage, eighteen recovered and two died, a mortality of 10 per cent.

One of the cases which died was a typical cretin, age three years and eight months, who had received large doses of thyroid extract since the age of twenty-six months. The present illness began with a temperature of 104, vomiting and marked prostration. The following day there were twenty stools containing blood and mucus. The bacteriophage treatment was begun on that day. The stool culture proved this to be a Bacillus dysenteriae Shiga infection. Three days later the stools were reduced to six in number and the temperature ranged from normal to 101. The pulse rate, however, was between 170 and 200. That night the child died.

The other case which terminated fatally was a baby 21 months of age. The onset began with a temperature of 104. There was an average of fifteen stools daily containing blood and mucus. This case came under observation for the first time nine days after the onset, and was the only case in the series in which the treatment was not started during the first week. There were only four stools on the fifth day after treatment was begun. None of these contained blood. The child appeared to be in good condition and was very hungry. On the sixth day, while playing around the house, she ate some green apples. Early the next morning she had a convulsion and died six hours later.

We have reported these two cases in some detail since they constitute the 10 per cent mortality in this series.

Of the eighteen treated cases which recovered, the average time between the beginning of the treatment and complete recovery was 5.8 days. In no instance was there a recurrence. An interesting fea-



ture in these cases was the fact that the appetite became normal when the symptoms subsided.

Twelve cases of bacillary dysentery were treated at the Dallas Baby Hospital during the same months and during the same epidemic. The treatment in the Hospital consisted of protein milk, skimmed milk and barley water, bismuth, sodium bicarbonate, hypodermoclyses, intraperitoneal injections of glucose and normal salt solution and colonic irrigations. The ages of these cases varied from twelve months to two years. The average time between the onset of symptoms and the admission to the Hospital was six and a half days. Five of these cases terminated fatally, a mortality of 40 per cent. This mortality is near the average mortality in those series of cases of this disease which have been reported. The average time between admission to the Hospital and complete recovery was 12.8 days in the eight cases which recovered.

SUMMARY

In this report there are twenty positive cases of bacillary dysentery (nine due to Bacillus dysenteriae Shiga, eleven to Bacillus dysenteriae Flexner) which were treated with the bacteriophage. There are twelve control cases which occurred during the same epidemic which were not treated. The clinical picture in all of these cases was typical of the disease. The mortality of the twenty treated cases was 10 per cent. The mortality of the twelve untreated cases was 40 per cent. In eighteen treated cases which recovered the symptoms disappeared on an average of 8.9 days after the onset and on an average of 5.8 days after treatment was commenced. In the control series which were not treated with the bacteriophage the average time of recovery in the eight cases which recovered was 19.3 days after the onset of symptoms and 12.8 days after hospital treatment was begun.

CONCLUSIONS

(1) The therapeutic use of the bacteriophage in the treatment of acute bacillary dysentery in children will greatly lower the mortality.

(2) The earlier in the course of the disease the treatment is begun the better are the chances for an early recovery.

(3) In those cases which recover the treatment with the bacteriophage will greatly shorten the duration of the disease.

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DISCUSSION—SYMPOSIUM ON DIARRHEA

Papers of Dr. Davison, Dr. Wilson, Dr. Womack and Dr. Spence

Dr. L. R. DeBuys, New Orleans, La.—The paper of Dr. Davison is one of the best that I have heard on the subject of diarrhea in infancy. It shows an extensive study of the entire subject. We know there are almost as many classifications of diarrheas as there are doctors.

Dr. D. Lesesne Smith, Spartanburg, S. C.—The subject of educating the public is the largest problem we have in the prevention of diarrhea. It is being done by preaching clean milk, good milk and boiled milk. If we can get clean milk and boil it, we shall reduce the mortality more rapidly.

Another subject that has impressed me is the feeding of trash, and when I say trash I mean anything that is fed between meals. The dangers of irregular feeding should be impressed upon the mothers. Most of the children who come before us with diarrhea are the fat, chubby, healthy looking specimens from the mothers' standpoint. They are attacked by diarrhea more often than the others who are nearer normal in weight. We should educate the public that the fat baby is not always the healthy baby. Those are the ones who resist diarrhea more poorly than any of the others. I find that a great many of my babies who have diarrhea are fed ice cream cones. I think the ice cream cone in the South is one of the worst things we have to contend with. We should preach against ice cream cones.

The third greatest evil is the administration of drugs. The child gets a little sick and is given calomel and castor oil and his resistance is lowered. We have diarrhea following the administration of these drugs.

The education of the public to the importance of feeding the child in the months before the hot weather begins I think is one of the important things we have to consider in our country. The administration of a great deal of water during the summer months, as Dr. Wilson brought out, is quite important.

Dr. Eugene Rosamond, Memphis, Tenn.—Dr. Wilson gives the predisposing causes of diarrhea as: age under 2 years, the summer season, defective hygiene, eruption of teeth, improper food. For "eruption of teeth" I would substitute "parenteral infection."

The age needs no discussion, for babies resist infection poorly.

The summer season has always stood out as the one great factor in the production of diarrhea. But heat as a predisposing factor acts in other ways than by exhausting the resistance of the patient.

We Southern people have only recently begun to learn how to protect ourselves from the hot weather. We have, most of us, gotten rid of our mosquitoes. We have forced, through ordinance, our people to screen against flies, forced our merchants to keep our foodstuffs screened and refrigerated, our milk to be pasteurized or certified. We have only recently taken the woolens off our babies' bellies and put them to sleep in places other than high walled cribs and bassinets. We are wearing more white clothing in the summer time. We ride in covered and quickly moving automobiles instead of horseback in the sun. Some day we shall learn to take siestas in the heat of the day like our more Southern neighbors and to utilize and enjoy more our glorious moonlight as does the negro.

When we learn properly how to protect ourselves and our babies from the heat, when we teach the people and the profession to fear dysentery infection as they do typhoid; when we teach people to care for milk better in hot weather; when we teach them not to make such simple mistakes as to put hot milk in a thermos bottle for a night feeding or an automobile trip; when we learn to hunt for draughts in which to let our babies sleep on hot days instead of avoiding them; when we do these and many more things that in time we will do, I do not believe that hot weather *per se* will be considered the chief exciting cause of diarrhea.

I doubt the wisdom of Dr. Wilson's advice to retain some breast milk during the summer for a fifteen months old baby. I cannot agree with him that no green vegetable should be given under two years of age.

I would add that milk, even though certified, must be boiled in the summer, in the spring, in the fall, and in the winter.

Dr. W. P. Cornell, Columbia, S. C.—I wish to suggest, as a preventive measure against the great baby-killer, non-bacterial summer diarrhea, maintenance of sufficient protein in the diet during the winter and spring months. About 2,500,000 babies were born in 1922 in the registration area, 65 per cent of whom were born in rural districts. That very many of these babies are fed upon proprietary infant foods is, I think, borne out by these figures, which represent approximate annual sales: condensed milk, $11,000,000; Mellin's Food, $2,500,000; Horlick's, $5,000,000. A total of seventeen and a half million dollars is spent annually for these proprietary infant foods.

Holt says that 95 per cent of deaths from summer diarrhea occur in the artificially fed and I would add, as the third cause which connects up these two, protein starvation. Physiology teaches us that protein is the only food element that builds the body tissues and that it is in these tissues that our vitality and resistance reside. If we are deprived of sufficient protein in our diet we immediately begin to consume our own body protein, thus gradually bringing about a malnutrition in which our resistance is lowered and digestive functions are impaired so that food products ordinarily acceptable can produce diarrhea.

Condensed milk, Horlick's and Mellin's foods and other similar and so-called "baby foods," when diluted so as to bring their high sugar content down within safe limits for administration to a baby, become totally unbalanced and contain far too little fat and protein, and it is especially this protein deficiency which causes the infants to consume their own body protein over months of time and thereby have lower and lower resistance and become in better and better shape for the heat of summer to prostrate and in them to produce diarrhea. Heat stroke is not so common, but I believe heat exhaustion is fairly so. Prevention, then, I would say depends upon maintenance of protein intake. Mother's milk should be used first and always, and if this is not possible then cow's milk, clean of course.

Dr. Robert L. Felts, Durham, N. C.—The most important thing to be considered in diarrhea is the prevention. I am glad to hear that the attitude toward boiled milk has been changed. During the past eight years I have fed children under two years of age and including the second summer boiled milk, as Dr. Rosamond said, summer, fall and winter. Coincident with the use of boiled milk I have noted a reduction in summer diarrhea.

During the last winter I saw a child, eight months old, who had been under the care of a pediatrician in Chicago, and who was having green vegetables. The child had an attack of diarrhea in the winter months. The mother stated that the baby had diarrhea almost the entire time, but she had persisted in using green vegetables. After one year of age green vegetables added to the diet are rational.

Dr. St. George T. Grinnan, Richmond, Va.—I suppose 90 per cent of the children who come into the Memorial Hospital at Richmond belong to the class who use proprietary food.

I do not find that a baby should be nursed for fifteen months. If a child is not on the breast you can start orange juice at two months and usually there is no use in waiting until symptoms develop before you start it.

Many children get in a condition of scurvy early and even of rickets. These might be prepared for the summer if cod liver oil were started in March and used for a certain time. It is necessary to start treating these children in February or March if you wish to prevent these diseases.

I would like to ask Dr. Davison whether the fermentation which causes acetic acid, butyric acid, and other acids does not wound the intestinal canal? Is it not acetic acid that is used to take off corns?

Dr. J. LaB. Ward, Asheville, N. C.—Several men have spoken of the importance of having certified boiled milk, with which I heartily agree. We often have to treat patients in homes where there is no ice box or means of keeping the milk. When we are certain that the milk is not going to be kept on ice, powdered milk is of value.

Levy, of Richmond, some twelve years ago demonstrated very conclusively in bacterial diarrheas that the infection is spread from house to house by flies. He divided the city into sections. In one section a nurse went from house to house teaching the mothers to screen against flies and to disinfect the stools as they were passed. In the other section this was not done. In the section in which it was done diarrhea decreased 50 per cent.

Dr. R. M. Pollitzer, Charleston, S. C.—It is extremely difficult in so variable a disease as infectious diarrhea to draw conclusions as to the efficacy of any form of treatment. Fluid and food are essential. To prevent dehydration, especially where there is much purging, water must be supplied by one route or another. Where the need is urgent the intraperitoneal injection apparently gives excellent results. Supplying water should and probably does lessen the danger of secondary acidosis.

Purgatives are not indicated at any time in the course of an infectious diarrhea, and in some cases do much harm. Except in late cases food is not so necessary for the first twenty-four hours. But throughout the disease it is essential. In most instances protein food is most helpful. Opium should not be used as a routine procedure. Yet where there is excessive peristalsis or great pain or even much discomfort it is beneficial. In general very few drugs are indicated. Bismuth has a reputation and is used by many. If it is used, large doses should be prescribed. But far too many drugs are given, often with injury. Colonic irrigations appear to be beneficial frequently, yet there are instances where, through too much handling, exposure and pain, they seem out of place. Most patients who are properly fed and filled with sufficient water will recover.

Dr. W. L. Funkhouser, Atlanta, Ga.—When lactic acid milk was first introduced we thought we had a specific for the treatment of infectious diarrhea. Then, when Kendall's work came out, we thought we were dealing with a definite organism which could be influenced by diet. If a certain organism was present we were to give protein milk; if not, carbohydrate feeding. After a time we found out that it made no difference what type of infection we had. We could give any food if we fed the patient and kept the fats low. I think we should look on infectious diarrhea as analogous to typhoid fever. It is a self-limited disease. We must treat the patient and let the infection take care of itself. We should give amounts of food suited to the digestive capacity of the individual. I hope that the bacteriophage will prove to be a specific treatment for infectious diarrhea.

Dr. W. W. Harper, Selma, Ala.—Often a hypodermoclysis fails of absorption because the blood stream is hypotonic. If the blood stream is rendered hypertonic by administering a 10 per cent solution of laboratory dextrose, 10 mils per pound of body weight, then a hyperdermocylsis or intraperitoneal injection of sterile tap water or normal salt solution will be very rapidly absorbed. Do not give dextrose solution intraperitoneally or by hypodermoclysis, as this reverses the osmotic current. In children the best vein for intravenous use is the femoral. This can be identified by locating the femoral artery at Poupart's liga-

ment and remembering that the vein lies just to the inside of the artery.

Now that it is fairly well established that acidosis, complicating summer diarrhea of infants, is due to a failure of the carbohydrates completely to oxidize the fats, I would suggest that we use insulin in such cases, preceding the administration of the insulin by an intravenous dose of dextrose.

In those cases where there are frequent bloody stools with much tenesmus I have found great relief to follow an enema of half a pint of a 1 per cent solution of silver nitrate followed in a few minutes by a weak salt solution.

Dr. L. W. Elias, Asheville, N. C.—Dr. Wilson's good paper unfortunately advised leaving out vegetables and fruit in the first two years. He said in the first place, "put the baby in the best condition possible," and then he took away the things that will help do it. I remember a discussion by Dr. Hess, of New York, in which he stated that all children on artificial food should have orange juice in the first month. Dr. Holt said it was all right, but not necessary before the third month. One doctor mentioned the bad effect of vegetable juices in the first year of life. If a baby is having diarrhea it should be studied as to its capacity. But it has to have food, as metabolism is much more active than at other times.

Dr. Harper's method of giving fluid and then something to remove it means that he is sucking water out of every tissue in the body. Would it not be much better to give a more dilute solution of glucose intraperitoneally?

Dr. S. A. Visanska, Atlanta, Ga.—I wish to bring out the treatment of one of the end-products of diarrhea, tenesmus with ulceration. While a minute dose of opiate is justifiable, much can be done to relieve these little sufferers by local treatment. One of the mistakes made by laymen and physicians is giving large and repeated doses of castor oil, which is converted in the small intestine into racinoleic acid, which irritates an already inflamed mucous membrane. When castor oil is used locally it soothes and allows the healing process to take place. Therefore, I combine argyrol 3 drachms in a 50 per cent castor oil emulsion. Take a No. 12 soft rubber catheter and cut it off about three inches from the tip, and with a 4 drachm hard rubber syringe draw up 2 drachms of the emulsion, placing the tip of the syringe in the mouth of the catheter. The catheter is inserted about one and a half inches into the anus and held tightly by compressing on either side with the fingers of the left hand. Insert the solution slowly and withdraw the catheter quickly, keeping the anus closed for at least half an hour by using a piece of adhesive across the buttocks. This can be repeated as often as necessary, preferably after a stool. If this preparation is made and used properly the condition will improve in a day or two.

Dr. W. A. Mulherin, Augusta, Ga.—Dr. Davison has given us a highly scientific paper. The tendency today is to believe that all diarrheas are traceable to focal infection. Dr. Davison has shown that we must go slowly for the reason that we can at times correct the diarrhea and let the infection alone. There is nothing that will prevent dysentery and diarrhea better than breast milk. Of course mothers can nurse their babies. There are five essentials to increased breast feeding: first, conviction on the part of the physician; second, to convince the mother that she can nurse her baby; third, to stimulate the breasts at certain definite intervals with ten minutes' nursing on each breast; fourth, to empty the breasts by manual manipulation; and fifth, to persist.

I do not agree with Dr. Wilson about anticipating trouble in the summer by letting the mothers nurse the babies fifteen months. Raise the vital force of the baby and it will be less subject to diarrhea.

The child with dysentery does not die because the bowels are infected. It dies because we starve it or give too little water. Its vital force is lowered and it gets a bronchial pneumonia or developes acidosis from desiccation of tissues. We shall overcome our dysentery by feeding our babies and giving them water. That is the one big advance we have made in pediatrics.

Dr. William Weston, Columbia, S. C.—Regardless of what pediatric subject may be under consideration, discussion eventually comes back to the matter of infant feeding.

We know that potentially breast-milk in sufficient quantities is the best preventive of nutritional disturbances that we can possibly use in the feeding of an infant, but experiments made in the last two or three years have suggested the strong probability that mother's milk is influenced to a much greater extent than was formerly suspected by her diet. We have been sure for some time that the milk of the cow does not contain water-soluble B vitamin unless she receives fodder in her food ration.

An important observation has been made in the young children of the Arabs. The mortality rate among these children from intestinal disturbances is so small as to be negligible. These babies are nursed by their mothers for a time and are then given sour goat's milk. This observation should be of value to us in solving our feeding problems. My experience is that bottle fed babies during the first or second year when given lactic acid milk become practically immune to intestinal disturbances. We feel that a much higher percentage of fat can be taken and digested in the form of lactic acid milk than in either raw or boiled milk.

Vegetables may be given safely after the first year and often before that time. The preparation of vegetables is an important factor in determining their effect and value. By the administration of vegetables I simply mean the residue after boiling, the well known "pot liquor" of plantation days.

Dr. E. D. Smith, Louisville, Ky.—It is absurd to take a number of vegetables, combine them, boil them, and feed them for the first time to a young child. The theory of desensitization is well known. We can feed railroad spikes, if we first begin to feed tacks. If we first begin to feed one vegetable in infinitesimal doses we shall be able soon to give the child a combination of

vegetables. Some of the disastrous results that I have seen came from this polyvalent vegetable feeding. Often our failures are due to promiscuous and unwise combination of vegetables in the first feeding.

Dr. Davison (closing).—I should like to disagree with Dr. Wilson that the mortality in dysentery varies in different states. The average mortality is about 30 per cent both in Birmingham and in Baltimore. Last summer Dr. Lawson Wilkins and I used prophylactic injections of dysentery vaccine in an attempt to reduce the incidence of dysentery in a foundling asylum in which the disease had always been prevalent. Heretofore prophylactic dysentery vaccines had produced severe reactions because they contained Shiga bacilli in addition to those of the Flexner variety. Inasmuch as more than 90 per cent of the cases of dysentery in children are due to an infection with the Flexner bacillus, we used a monovalent Flexner vaccine. No severe reactions were produced. Only one case of dysentery occurred after the inmates of the institution had been immunized. The boiling of milk in its final container is important. Milk is rarely infected with dysentery bacilli at the dairy, but is very easily contaminated when handled in the home. The child's milk or milk mixture for the whole day should be divided into the requisite number of feedings. Each feeding should be poured into a clean nursing bottle. This should be plugged with non-absorbent cotton. All of the bottles should then be placed in a pan of cold water and boiled ten minutes. These boiled bottles should then be kept on ice until needed, but even without ice they may be kept twenty-four hours without becoming spoiled. This procedure has undoubtedly reduced the incidence of dysentery in Baltimore.

The epidemiology of dysentery is unproven. Flies are probably important factors in the spread of the disease. Stools are usually saved for the physician's inspection and unless he instructs the mother to place the stools in a covered receptable, flies will gain access to them. The incidence of dysentery in neighboring houses can frequently be traced to this source.

Dr. Womack stated that carbohydrate and water feeding is as efficacious as a high protein diet. I do not believe that this is true in the treatment of simple (non-infectious) diarrhea or in dysentery in infants of less than one year. We feed them all with lactic acid milk or protein milk in Baltimore. In cases of dysentery over one year of age, the type of diet is apparently unimportant during the first three or four days of the disease, for the results of several varieties of feeding which I have observed in other cities are much the same. I feel that diet is very important during convalescence and that the latter is more rapid if a relatively high protein and low carbohydrate diet is given.

I have treated several cases of dysentery with the bacteriophage by administering large amounts (over a quart) by rectal tube and by mouth, but the mortality was not reduced. I treated most of these children after the seventh day of the infection. I do not think that the cases which Dr. Spence reported were well controlled. The mortality in private practice cannot be compared with the mortality in twelve cases treated at the hospital. The mortality at the hospital is higher than at home because the more severe cases are usually sent to the hospital. This type of treatment should be given a trial because it is absolutely harmless. I have injected large amounts of bacteriophage into animals and have taken some of it myself without producing any reaction.

In answer to the question about acetic acid, the concentration used to produce diarrhea in dogs was very much less than that used to treat corns. When given in small amounts it produced no lesions except a slight hyperemia of the intestinal mucosa.

Dr. Wilson (closing).—My opinion is firmly grounded upon sad experience, that fruits and green vegetables are not safe for children under two years of age in the summer. The food value of green vegetables is almost negligible. It is the salt content which is necessary. It has been found by Fales and Courtney, working under the direction of Holt, that when green vegetables are boiled in water half of the salt content is lost into the fluid. If the full value of green vegetables, then, is desired, they must be cooked over water in steam in a double boiler, not in water, because half of the salt content of the vegetables then remains in the strained water, the pot liquor.

In the summer, if you wish the salt content, use a strained soup or pot liquor, which gives you the salt content without the irritating effects of the vegetable fiber.

Boiled milk should be used from January 1 to December 31 with orange juice as an anti-scorbutic. But mothers object to boiled milk on account of its apparent constipating effect. Sometimes in the winter raw milk is permissible, but always boil milk from the first day of May until the first day of November.

Dr. Womack (closing).—One-third of these cases die in the chronic stage and two-thirds in the acute stage of diarrhea. Those who die in the chronic stage die from the inability to assimilate food. This past summer I have been using the ultraviolet ray over the abdomen. It does raise the hemoglobin rapidly. It also seems to increase the ability to take and digest nourishment. In cases where everything possible should be used to increase the patient's chances for getting well, the ultraviolet ray will find a distinct place.

Dr. Spence (closing).—I agree with Dr. Davison that you cannot compare the results obtained when treating private patients with those obtained when treating hospital patients. Hospital patients are usually very sick, while the same infection among private patients is sometimes comparatively mild. In order to make possible a comparison of the severity we have grouped the symptoms in the two series reported. Judging by the results reported in the literature and by the results we obtained in our series of cases, we believe that we are justified in concluding that the bacteriophage has enormous possibilities in the treatment of acute infections.

A CASE OF TULAREMIA

By E. G. MARTIN, M.D.,
Benoit, Miss.

On April 27, 1924, I was called ten miles out of town to see a case of "fever." The patient was a colored woman, aged 42, whose temperature was 103°. Her pulse was 120 and very weak. She had no appetite. There was nausea, vomiting, and diarrhea. Her tongue was small, red, and her mouth dry. The general appearance was that of typhoid fever in the third week. She gave a history of a severe chill one week previously, followed by a continuous fever except for slight remissions.

A physician had visited her four days previously and cinchonized her thoroughly with no relief from fever or other symptoms. In fact, the vomiting had supervened since his visit, but was probably due to the toxemia rather than to the cinchonism. The chest was negative except for a few rales. There was no rigidity of the abdomen and no tenderness except such as one would expect to be present from the vomiting. I took a blood specimen and later got a negative Widal from the laboratory.

She made no complaint of any local trouble, but I noticed that one finger was wrapped up in a rag. On questioning her I learned that about two weeks previously, while dressing a rabbit, she had stuck a fragment of bone into her finger and that it had given her very little trouble until the last three days, since when it had become very painful and radiated up the arm and prevented her from sleeping.

On taking off the bandage I found that the finger was not swollen and there was no evidence of lymphatic or glandular involvement. There was a very dark reddish spot about the size of a dime on the distal phalanx of the third finger, palmar aspect.

I anesthetized the finger, removed the dead cuticle and found a dark red necrotic spot, extending down to the tendon but not involving it. I removed the dead tissue as thoroughly as possible with curved scissors and put on a gauze dressing and instructed her to keep it wet with a saturated solution of boric acid and to report to me in 24 hours. On the third day the patient's husband reported that she was about free from pain, nausea and fever; so I supplied him with gauze and boric solution with instructions to continue the same routine.

The finger was very slow in healing, so I kept up the wet dressing for four weeks, at the end of which time the patient came to my office and I found that the finger was nicely healed, but with fibrous ankylosis of the middle and distal joints.

Her appetite and nutrition were good except that she was suffering from a toxic goiter which seemed to have been made worse by the infection.

A few days later I came across a paper in the *Journal of the American Medical Association,* May 17, 1924, by Dr. J. Russell Verbrycke, of Washington, D. C., describing a case of "Tularemia." From this paper I learned that the Bacterium tularense was discovered and named by McKoy and Chapin, in 1912, having been isolated from ground squirrels in Tulare County, California. Later, it was isolated by other investigators from rabbits and it was found to be transmitted to human beings by the bite of a blood-sucking fly, infected by biting diseased rabbits. Finally, in 1922, Francis, after extensive investigations, described the disease and called it "Tularemia, a new disease in man."

It seems that the disease is contracted from the bite of an infected fly, or from handling infected rabbits. Also laboratory workers handling the cultures are almost sure to be infected and in this latter case there is no local sore.

The disease resembles typhoid fever or septicemia and is readily mistaken for one or the other if the mild local sore is overlooked. After seeing this sore once it is unmistakable, and is as pathognomonic as Hunterian chancre or an anthrax pustule. Also one can obtain the history of the bite of a fly or the handling of rabbits.

This disease was probably like the plague, imported from the East, and there is a striking similarity in the infection of ground squirrels by the plague some years ago. Most of the cases have been reported from the Western states and it is gradually spreading over the country. Several cases have been reported from Southern states, but this one, I believe, comes from the farthest South so far.

The treatment is symptomatic, the prognosis is generally favorable, though some cases run a rapidly fatal course.

SUMMARY

The history of the infection, an incubation of about four days, a fever like typhoid of sepsis, and the mahogany colored sore with little or no local symptoms, make a clinical picture which will rarely be mistaken a second time.

TROPICAL DISEASES AND PUBLIC HEALTH
SYMPOSIUM ON MALARIA

SOME DIFFICULTIES FROM AN ADMINISTRATIVE STANDPOINT IN THE CONTROL OF MALARIA*

By S. W. WELCH, M.D.,
State Health Officer,
Montgomery, Ala.

One year ago I made a report on the malaria control work in Alabama, which showed a fall in the death rate which approached the spectacular. I expected this fall to continue year by year until there was no more malaria in Alabama. In this I have been disappointed. Our efforts for the past season have not been so productive of results as heretofore. The death rate, instead of falling, as it was expected to do, has shown a slight rise. This failure in the continuous fall in the death rate has caused us to look around for the discovery of the reasons of our failure. This survey of our methods has outlined rather clearly some errors in administration and discovered difficulties which we had not previously taken into account.

The magnitude of the problem is disconcerting. The distribution of malaria in Alabama is statewide, while the forces engaged in its control are but a handful. It requires courage and enthusiasm to believe in oneself sufficiently under these circumstances to tackle the problem with hope of success.

The first step in the solution of every difficulty is a confident belief in oneself; in one's ability to grasp intelligently the magnitude of the problem, its drawbacks, and its disappointments. We feel that we have taken this step in Alabama and have gone about the task of eliminating lost motion and misdirected effort.

There are a few counties in Alabama in which malaria is not a problem. Those counties in which it is a problem present difficulties of a varied nature. The plan which we adopted a year ago of dividing the state up into districts and placing an engineer in charge of each district we believe is fundamentally sound. The territory, however, has been so large that the engineer has not been able to concentrate his efforts on the several foci of infection sufficiently well to make a showing. This brought about discouragement to him and a loss of some of his enthusiasm. The first work we did was urban and brought such positive and such spectacular results as compared with the work which we are now doing that it has had a tendency to cause the engineer to slow up in his efforts. We have, however, established certain facts in regard to the prevalence and distribution of the disease.

We now know that malaria is a rural problem in Alabama. The urban centers have the pest mosquito, but few centers of population now have any malaria infection. The breeding places of the malaria mosquito are in the country, and the thickly settled districts are the localities in which it is now prevalent. The difficulty of reaching these individuals in isolated dwellings is great. When reached, each has to be talked to individually. It is hard to assemble them in groups sufficiently large for effective educational effort. Drainage, screening and quininization are difficult to apply in the rural districts because of the lethargy of the population and the difficulty of impressing them with the importance of control measures. The fact that they have been accustomed to malaria throughout their lives, and the doubt in their own minds as to the efficacy of the remedies suggested, make it hard to get their cooperation.

It is difficult to institute drainage projects on a large scale for several reasons:

The abundance of land in Alabama makes it difficult to convince land owners that they will be benefited from a financial standpoint by draining their swamp areas. The majority of land owners at the present time have as much tillable land as they can cultivate. It is difficult to convince them of the economic value of draining other lands when this is the case. Again, owners of land usually have their premises located in places where drainage is good and mosquito control easy. Consequently they do not suffer from the disease. The population afflicted with malaria is, as a rule, tenants, who have not the means or the financial incentive, if they could be convinced of the efficacy of draining these swamp areas and screening their houses.

Again, the meagerness of governmental appropriations makes it impossible for the health workers to offer sufficient aid to owners of land to bring about action on their part.

Again, the coordination of the work of the engineer with the county health officer is a task we have only partially succeeded in. The viewpoint of the medical man and the engineer in the control of malaria is not the same. The work

*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

of bringing sufficient compromise of the opinions on the part of each and welding them together in a sustained and harmonious effort is sometimes difficult.

What is the solution? We must have engineers in districts to help the health officers, but other things must be added to bring success. An epidemiologist must be added, whose duty will be to locate in every county the area in which malaria exists. When this is done we must concentrate our efforts upon these foci. This concentration will consist of obtaining a sufficient amount of local aid to add an inspector, who will work under the health officer, the engineer devoting his entire time to the rural project. Where feasible, large drainage projects will be organized with the help of the Agricultural Department. We shall watch closely for other errors in administration, avail ourselves of every suggestion arising from scientific investigations going on in the field, and turn each to practical account. We shall enlist the interest of civic organizations, women's clubs, educators and public school children in the work, and above all things preserve and stimulate the confidence and enthusiasm of the workers in the field. We feel that while it may take us longer than we at first believed it would to rid Alabama of malaria, our enthusiasm is undaunted and our faith in our ability to accomplish the results is as great as the day we began.

DISCUSSION

Dr. L. D. Fricks, Surgeon, U.S.P.H.S., Memphis, Tenn.—Dr. Welch had apparently secured such wonderful results in the first year of his work that he was astounded the next year to find that the malaria rate did not decrease as was expected, but apparently increased. Such occurrences are natural and easily explained. In the first place, we do not know how much malaria we have in the South. Nor is there any exact measure of malaria prevalence that can be practically applied in any community in the South under existing conditions.

Of course, all of us who know anything at all about the problems of public health administration in rural districts know that these problems are very great, and we cannot expect miracles in malaria control at the present time. Education is slow; appropriations are slow; development of competent county health officers and their co-workers is slow. Yet, while the decrease in malaria from year to year may be slow when measured in terms of ten years or so, I do not hesitate to prophesy that there will be a material reduction of malaria in Alabama as a result of the effort Dr. Welch is making for its control.

Mr. J. A. LePrince, Senior Sanitary Engineer, U.S.P.H.S., Memphis, Tenn.—We are using the county as the unit area for control in eliminating malaria, and our representative in doing this work is the county health officer. The public will want malaria control, generally speaking, when the county health officer is able to convince it of the need for malaria control, so we have to rely largely upon the county health officer. If the county health officer is not quite sure that he can accomplish results in malaria control, there may be a tendency on his part to concentrate on other work, so we must do all we can to get our county health officers intensely interested in the possibilities of malaria control. It is not easy work by any means, but it is well worth while. It is also work that is sometimes difficult to start. There are many areas in which we have to consider the individual home as the unit, so we have to interest all the people. Our biggest problem today is to help the county health officer to sell the desire for malaria elimination to the farming population.

Dr. John A. Ferrell, International Health Board, New York, N. Y.—The increased number of cases recorded in Alabama during the past year may be due to Dr. Maxcy's exceptionally thorough work in locating them. It is doubtful that there was such complete reporting of the cases during the previous years to which Dr. Welch refers.

In the county Dr. Welch has a health organization composed of a physician, a public health nurse, a sanitary inspector, and an office assistant. Occasionally a larger number of staff members are employed. The physician acquires by experience aptitude for his duties. He cannot qualify as a malaria epidemiologist or as a sanitary engineer; but he can obtain assistance in his epidemiological problems from Dr. Maxcy and sanitary engineering assistance from staff members of the State Board of Health.

I believe the malaria rate is being rapidly reduced in Alabama.

Dr. Welch (closing).—The statistics upon which this paper was based are the 1922 statistics. The statistics for 1923 are not yet available. I felt that, having made the report last year, which showed such a marked reduction, I was due the malaria workers in the field a statement of our failures in 1922.

I believe that the reason why we made less progress in 1922 and 1923 than we did before was the lack of enthusiasm in the workers in the field, and, incidentally, a meeting of the State Legislature, which prevented me from giving the malaria work my attention.

THE EFFECT OF VARIATION OF LEVEL OF IMPOUNDED WATER ON THE CONTROL OF ANOPHELES PRODUCTION*

By H. R. CARTER, M.D.,
Assistant Surgeon-General, U. S. Public Health Service,
Washington, D. C.

The problem of the effect of impounded water upon the incidence of malaria was formulated in the fall of 1913, about ten years ago, and the first work in its investigation was undertaken the next year at Blewetts Falls, N. C., on the Pee Dee River.

The original plan for this investigation, which was purposed to include a determination of the methods for the control of this incidence and to an extent at least of the evaluation of the effect of the methods recommended for this purpose, was expected to require not less than five years', or rather seasons', investigations. We thought that the evaluation of the methods for control of malaria above alluded to might well require three or four years longer time.

The problem was a large as well as an important one, as on it, to some extent, depended whether the water power in the malarial sections of the United States could be developed economically or whether the damage which its development would cause the health would be so great that this development would not be economically possible, or that its value would be greatly lessened.

It was purposed that the research on the ponds as normally made and that of the methods to control the production of Anopheles thereby should go hand in hand as soon as we had enough knowledge of the first to warrant institution of the second.

Only three seasons (1914-15-16) were available for this research before the war stopped us. Some little data was collected incidentally on this subject during the war, but very little. Griffitts and I made one survey in 1919 and I, sometimes by myself and sometimes with others, have done some surveying within the last three years, some of the results of which are in this paper. Dr. Fricks this year has also formally taken up this problem again and, I presume, will finish it.

It was determined during the surveys of 1914-15 that, except where floating islands, log rafts, etc., existed, Anopheles production in these large ponds occurred only about their edges and, indeed, far the greater proportion occurred on their edges, even in those like Parr Shoals and Stevens Creek, where rafts and floating islands were abundant.

Naturally means of control of production in the ponds were practically two: wave action, which drowned the larvae, and fish which ate them. Of course there were cases where predatory insects assisted the fish, but as compared with them these insects were of very minor sanitary importance.

All large ponds that we came across, by the third year at any rate, were fairly well stocked with top minnows, either derived from those which had existed in pools covered by the pond or artificially introduced. Nevertheless, even in ponds like Parr Shoals, where Gambusiae were abundant, there was frequently large production of Anopheles on account of the protection furnished the larvae along shore by the drift and floatage which naturally accumulated there, especially in the bights and bays of the shore line.

Taking into consideration, then, the two means for the natural control of production on the ponds it was easily seen:

(1) That we could do nothing to increase the efficiency of wave action save to draw out a few obstructing log rafts and heavy drift. This was a question of topography.

(2) That our best, and almost only, chance for control lay in getting a clean water edge for our ponds so that the larvae having no protection against the fish would be destroyed by them.

Beyond the preparation of the flowage are before the filling of the pond, for which we had formulated specifications, it is very obvious that this edge cannot economically be kept clean of floatage and drift by mechanical means. This was indeed attempted at Parr Shoals, S. C., a large body of men being employed all of one spring and summer in raking the edges of the pond. Of course it did some good, but it would have been cheaper to buy and abandon for settlement all the land within the distance of flight of the pond than to have continued it indefinitely. Naturally, it would have to be continued indefinitely. This was a small pond: Lock No. 17, Black Warrior, was estimated by Mr. LePrince and me from the plans submitted by the U. S. engineers to have over 132 miles of edge. Hand raking was obviously not to be considered for this distance.

As early as 1915 a plan for clearing these edges economically feasible was formulated and recommended to the Alabama Power Company at Lock No. 12 of the Coosa. This pond had been filled some two years previously, and being accred-

*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

ited with having caused a very large amount of malaria in its environment, was the defendant in a number of suits totaling a large amount. The plaint made against the pond was that it had been high in the spring of the year and, as it had been lowered from the use of the water, it left all its edges covered with "offensive mud bared to the hot sun and thus had produced a miasma which caused the malaria."

To obviate this alleged cause of the malaria the Company then put in a telephone line from near the headwaters to connect with the power plant so they might be forewarned of the coming or the passing of high water. Whenever this was threatened they opened their weir and lowered the pond in advance so that there would be no rise beyond what they counted their normal level. They put in also a supplemental steam plant and whenever the use of the water threatened to leave bare these "malaria producing mud flats" they drew on their water power the least possible, supplementing it by steam, thus doing all that was possible to keep the pond at a constant level. Incidentally, by keeping the drift at the banks afloat, they removed any possibility of fish control and thus increased the production of Anopheles from their pond as much as was humanly possible at very considerable expense to themselves.

It was recommended to them for the present to let the pond fluctuate as much as possible: to catch every rise, so as to bring the floatage high up on the bank and then lower the pond by use or otherwise as much as was possible so as to strand this floatage on the banks with the larvae that it sheltered as the pond went down.

The general recommendations for a pond already in existence as agreed to by LePrince, Griffitts and me, were formulated as follows:

(1) To hold the level of the pond as high as possible during the season when Anopheles quadrimaculatae were not producing; that is, the late fall, winter and as long as we could into the next season. This would kill the land vegetation up to this level. The drift and floatage accumulated during this period would also be collected along this margin of the water, extending a certain distance therefrom.

(2) Just prior, and as close as possible, to the first flight of Anopheles quadrimaculatus from the pond water, lower the pond as much as is reasonably possible. This would leave all, or nearly all, floatage and drift then floating against the banks stranded on them when the pond went down. The aim was (a) to kill the larvae in this floatage, and (b) to leave a clean water's edge around the pond.

(3) During the summer to catch and hold every rise of the river as long as possible, but less than two weeks, and then run the pond down to clean edges again.

Obviously, it might take more than one season of high level to kill all the land vegetation. Two, or at most three, would, however, do so.

Similarly, it might not be economically feasible to lower the pond enough to land all the trash floating around its edges at the beginning of the Anopheles production season. We have found, however, that the greater proportion of this floatage could be thus landed except where the banks are steep. Indeed, contrary to our first judgment, mosquito production on the gently sloping banks was more easily controlled than on the steep ones, as even a small fall of the level would, on the former, land a large area of floatage while on the steep banks a much less area would be landed for the same fall of the pond.

One can easily see, knowing the biology of Anopheles, how this plan ought to work for control of their production. As the water fell the larvae would be left stranded on the land; as it rose, especially if it rose rapidly, the masses of floatage would be, to an extent, broken up and the Anopheles larvae would be exposed to fish, and, for the great majority of the time, the water's edge would be clean and free from floatage, or in the worst possible condition for mosquito production.

It is not necessary to tell you, however, that we have never been satisfied with a method, however good it might be in theory, that had not been checked up in the field. We indeed saw a little of this around Talladega Springs, but not enough to be called a check of the method and it is this that I now wish to present to you.

In the spring of 1921, on my return from Peru, I was asked by the Superintendent of a large hydro-electric plant what measures could be then taken with his pond to prevent its being a source of malaria. His statement was that at that time (in May, I believe) the pond was level with the spillway. I advised him to hold it up as high as he could, to that level if possible, to about the end of June, or even a little later, and then lower it (whether by use or wastage) 2 feet or even 3 feet, and thereafter hold the rises and lower the level after them, as per the recommendation given above.

I visited this place on August 10 and lived with two other men in a tent on its bank in the upper reaches about 50 feet from the water. I stayed at this place for six days, the working days of one week. During that time only one mosquito was found in the tent. This was, unfortunately, mashed and its genus could not be determined. A considerable portion of the upper reaches of the pond was examined during these six days. The edges were practically bare, the floatage being landed well above the water and, except

where streams entered and on one log raft, Anopheles larvae were not found. There was in places a slight collection of drift along the edges, which had evidently come since the pond had been lowered (about July 10) but this was so slight that it seemed to furnish insufficient protection to larvae. At any rate, none were found in it. Top minnows were fairly abundant, especially near the mouths of the streams and in bights. Imagoes were not found in the houses that were examined more or less adjacent to the pond, and a fair number were examined.

Griffitts and I had been over this pond in 1919 somewhat later in the year, but with far less pains and taking less time than I put on it in 1921. We had found the edges far from clean and breeding in several places; also in some houses a fair or large number of Anopheles quadrimaculatus. All the places which had been found breeding in 1919 were examined in 1921 painstakingly, and in no single one was breeding found. In mouths of streams there was occasionally found a fair amount of floatage. Sometimes it was due to the banks being steep at this place so that it was not landed; sometimes, doubtless, to its being washed down the streams since the pond had been lowered. Where Spirogyra alga was found in this floatage we were apt to find larvae. A few of these developed into quadrimaculatus and hence were doubtless from pond breeding. The majority were Punctipennis and probably washed down from the stream.

This same pond was visited again this year in early August. It had been lowered intentionally about 16 feet. Two days' careful examination by three people (Dr. Boldridge, Mr. Gage and me) resulted in finding five larvae just below the mouths of creeks, which, in running water, were breeding, scantily, indeed, but manifold more than the pond was. The banks were generally free from drift and floatage. In some bights, however, this was found, especially near the mouths of streams. None of the larvae taken were large enough to justify attempts to develop them.

This examination, on account of my becoming sick, was not completed. I had expected to give at least six more days to it, but LePrince examined this pond in what seemed to be the most favorable places for mosquito production for some days and Mr. Gage also (the latter both before and after my imperfect examination). They will tell you what they found. Their results were negative.

Another large pond in South Carolina was examined by Dr. Boldridge and me with some pains in 1921. I was there about three weeks. The level of the pond was some 3 or 4 feet below the spillway at this time and the edges, except in the back-water of creeks, were clean. There was no breeding of sanitary importance found in the pond, or even in the back-water of the creeks, which were alive with Gambusiae. Portions of the same pond were examined by me for six days in the summer of 1922 with the same result. It was then some 2 feet below level.

Naturally, these observations are not nearly so complete as they should be, yet they are a beginning and I think the findings from them are sufficient tentatively to justify the recommendations made in 1915 and to show that the change of level of a pond lessens its production of Anopheles and can be so handled as well-nigh to prevent it. This, of course, applies only to production on the banks of ponds, not to log rafts and floating islands, which would be little affected by it. And, unlike hand-cleaning of the banks, this method of getting clean water edges is always feasible and probably in general economically practicable.

Obviously, the lowering of a pond from its early summer high water mark, if it is done simply by the use of the water, costs nothing and cleans the banks fairly efficiently.

If the use of the water does not accomplish this and the pond is cleared by wastage through the weir, this is done at considerable cost to the Power Company, yet it may be well worth doing as a sanitary measure. It was so done, intentionally, at the pond of which I first gave the history and I cannot but think that the production of Anopheles prevented thereby justified the expenditure. Indeed, from the little I saw and from LePrince's verbal reports,I think it is fair to say that at this time a unit area of the pond was producing fewer Anopheles than a unit of its land environment.

This method awaits and calls for further observation and development.

DISCUSSION

Dr. S. W. Welch, State Health Officer, Montgomery, Ala.—The State Board of Health, with the aid of Dr. Carter and a number of other authorities on the subject of malaria control, formulated some regulations governing impounded waters in Alabama. There has not been, so far as we know, a single impounded water, large or small, which has not asked the State Board of Health for a permit and followed the instructions of the Board, and the results have been all that we could ask. The impounded water of Lock 12, cited here, produced in 1916 and 1917 the greatest outbreak of malaria that the State has ever seen. Not a family within three miles of the impounded water on both sides escaped malaria. I do not know, however, whether that was due so much to the activity of the mosquitoes as to the activities of a lawyer who was stirring up damage suits, so that malaria became a very popular disease. Before that, when a man had a chill he suppressed the fact.

The State Board of Health had something to do with it, too. We required them to clear a certain area and took no precautions at all to keep infected laborers from getting in. The Power Company sent a corps of laborers gathered from the malaria districts of Louisiana, Georgia, Florida and Alabama up and down the river to clear the basin of timber. They infected every mosquito in the country, so the very means we took for malaria control served to spread the disease. But this last summer, instead of an infection of three miles on both sides of the river, there have been only five cases of malaria in the impounded water district. We have practically perfect control. The method is to give quinin as a matter of routine to every man who comes in. A blood examination is made in the laboratory to determine whether he has malaria, but even if he has not, he is given a course of quinin before being allowed to go to work. Those cases that have malaria are put in the hospital for ten days before being allowed to go to work, and after they go to work they are given a regular course of quinin. The Alabama Power Company officials are so delighted with the results obtained on the Mitchell Dam that, with no requirement of the State Board of Health, they are now coming to us for help in controlling malaria at Cherokee Bluff. They are constructing a fish pond for the breeding of top minnows and they are not going to do anything that will allow any floatage if they can possibly prevent it. They are going to burn all their floatage in the basin.

The principal cause, I think, for the rise in malaria last year was neglect of the State Board of Health to keep tab on a small impounded water and the failure of the man responsible for it to follow the instructions of the Board. He is this year building another impounded water, and he is not taking a step until he asks for the instructions of the Board.

Dr. Roy K. Flannagan, Assistant Health Commissioner, Richmond, Va.—Virginia has adopted the same regulations for impounded water as those mentioned and is getting equally good results.

Dr. L. D. Fricks, Surgeon, U. S. Public Health Service, Memphis, Tenn.—Obviously the development of the water power of the South is of enormous importance to the future welfare of the South, and thus indirectly will result in malaria control to a considerable extent. Apparently, also, after two or three years these impounded waters are usually not dangerous. They regulate themselves. But during the transition period it is important that the state boards of health take precautions to minimize these dangers. Such regulations have been adopted by the states of Virginia, North Carolina and Alabama.

I wrote to all the state health officers some few years ago calling attention to this problem, and I believe the health officers of Louisiana and Mississippi wrote that they had no impounded water problems in their states. Certainly they have no such development projects as Dr. Carter has referred to. I question, however, whether it would not be advisable for the health officers of all the Southern states to adopt regulations governing impounded waters, because everywhere water is being impounded for fishing and boating, for small mills and power plants. I think probably it might be well for us to take up this matter again at this time and determine whether practicable regulations should not be promulgated by every state health officer in the South governing all contemplated impounded water projects.

MALARIA CONTROL IN THE UNITED STATES: RETROSPECT AND PROSPECT*

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In a paper suitable for such a meeting as this one can hardly do more with the subject of malaria control in the United States, past and future, than indicate in the most general way the steps which have led up to or have actually been taken by health agencies for the control of malaria and the objectives to which it seems their efforts should be directed in the future. In thus limiting our discussion to active malaria control measures by the properly constituted health authorities we may appear to ignore the achievements of individuals, communities and commercial corporations which have been prompted by motives other than improvement of the public health. This is by no means our intention. As a matter of fact, by far the greater part of malaria control which has been effected in the United States in the past has resulted from individual and community effort to obtain better living conditions and increase their prosperity.

Suppose, for instance, the United States were inhabited by unprogressive mixed races. Suppose one-half or two-thirds of the farm laborers in the Ohio Valley consisted of negroes. Suppose that no industrial or agricultural progress had been made in the Southern states during the past thirty years. What would the malaria situation in the United States be under these conditions? The health authorities would then have a Herculean task upon their hands instead of one which is already partially solved and which promises reasonably rapid and complete solution in the future.

Ronald Ross states that the world requires at least ten years to understand a new idea, however important or simple it may be. If this statement is approximately true, it is not to be wondered at that nothing was consciously done for the control of malaria in the United States be-

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fore the present Century, since it was not until 1898 that he discovered the role played by anopheline mosquitoes in transmitting this disease and thus paved the way for the scientific control of malaria. A curious instance, however, of blind groping after malaria control is found in the early records of the city of Savannah, Ga., where it is stated that in 1817 the cultivation of rice on the lowlands adjoining the city had recently impaired the city's reputation for healthfulness by increasing the amount and severity of sickness occurring in late summer. As a result of a report made by the City Council at that time placing the responsibility for increased sickness upon these near-by rice fields, public sentiment demanded that they be abolished and Savannah, then a town of six thousand people, spent approximately $100,000 during the next few years in contracting with the owners of these lowlands to cease using them for the cultivation of rice and put them under so-called dry culture. In 1879, a highly important step was taken in the control of malaria in the United States, although it was intended merely as sick relief or at the most partial protection from chills and fever. The 20 per cent import duty on quinin was repealed by Congress and quinin was made duty-free. This step and the increased cultivation of cinchona, which was strongly encouraged by the Dutch and English governments at this time, enabled the struggling farmers of the South and Middle West to secure an abundant supply of quinin at reasonable prices. The importance of this to communities living under pioneer conditions can hardly be overestimated. It enabled many of them to clear their lands, cultivate their crops and live down their malaria. In 1823, quinin sold in the United States at $16.00 an ounce wholesale. From 1830 to 1880 it sold at prices ranging from $1.25 to $3.40 per ounce. After 1879 the price rapidly fell from $3.40 to as low as 21 cents per ounce, the average price during the eighties being around 60 cents and during the nineties below 30 cents per ounce.

Beginning with the year 1900, many isolated campaigns for mosquito control were conducted in the United States from Boston, Mass., to San Antonio, Tex. These campaigns for the most part were stimulated by bulletins prepared by Dr. L. O. Howard dealing with mosquito control. They followed the directions laid down therein and were generally prompted by a desire on the part of the communities concerned to rid themselves of mosquito pests and thereby improve living conditions; but most of them no doubt contributed to health improvement as well, and in one instance at least, the Staten Island campaign, health improvement was claimed as the prime objective. The anti-mosquito campaigns conducted in Southern cities during this period increased in popularity when it was learned that yellow fever, the justly dreaded scourge of the South, was also a mosquito-borne disease. The ease with which the outbreak of yellow fever in New Orleans in 1905 was controlled by anti-mosquito measures carried conviction to the mind of the general public throughout the South, thereby laying the foundation for future health appropriations for such purposes. So also the brilliant lessons which were being taught by American sanitary officers at Havana and on the Canal Zone were brought home to the people of the United States. If malaria and yellow fever could be controlled there in their hot beds by our health officers, was it not possible to do the same within our own borders? It appears, then, that many communities in the United States began to give serious thought to protection from mosquitoes about 1900, but since at that time their health departments were not prepared with organizations or funds to meet this demand the people were compelled to fall back upon their own resources and protect themselves as best they could. Thus there followed isolated mosquito control campaigns and an enormous increase in screening and the use of mosquito nets throughout the United States, for which millions of dollars were spent annually, and by which much malaria was avoided.

In 1912, the U. S. Public Health Service began the investigation of malaria in the United States by a preliminary study of malaria distribution in Alabama and making malaria and mosquito surveys around Mobile. These studies rapidly crystallized into a definite program of malaria investigations which was undertaken in 1913 and conducted in cooperation with the state health authorities concerned until interrupted by the World War in 1918. These investigations consisted of collecting malaria mortality and morbidity statistics, making malaria and mosquito surveys, conducting demonstrations in urban malaria control, educating the public in malaria transmission and control, and pursuing special malaria studies. In carrying out this program physicians throughout the South were requested to give information bearing upon the prevalence of malaria, from thirty to forty malaria and mosquito surveys were made each year. More than 26,000 blood smears were examined for malaria organisms, sixteen demonstrations in urban malaria control were made in nine Southern states and many malaria bulletins were prepared and widely distributed. This program was undertaken with an allotment of less than $3000 in 1913, which had been increased to more than $17,000 in 1917, after which it was interrupted by our entrance into the World War. Generally speaking, these demonstrations in malaria control were financed by the communities themselves or by the industrial concerns located in these communities, but the International Health Board financed the demonstrations made under the direction of service

officers at Crossett, Hamburg and Lake Village, Ark., in 1916 and 1917. At the same time the International Health Board and the State Health Department of Mississippi cooperated in conducting a successful study and demonstration of malaria control by quinin administration under the direction of Dr. C. C. Bass in Bolivar and Sunflower Counties. In 1916, the Cotton Belt Railroad was induced to undertake a comprehensive malaria control program along its lines.

Upon the entrance of the United States into the World War demonstrations of urban malaria control were discontinued. The Service malaria field force was augmented and wholly employed in the control of malaria and malaria-carrying mosquitoes around the army cantonments and war industries' plants which had been located in potentially malarious regions. Five hundred thousand dollars was appropriated by the U. S. Government for this work and a greater amount was contributed by the communities in which the cantonments and plants were located. The educational value of these extra-cantonment malaria control activities was very great. It was a revelation to many that soldiers could be mobilized in camps located in the South without suffering unduly from malaria.

At the close of the war extra-cantonment activities were discontinued by the Public Health Service and a cooperative agreement was entered into in 1919 with the International Health Board and ten Southern state health departments, three others entering later, with the object of resuming urban control demonstrations in all of these states and ultimately securing such favorable public sentiment toward malaria control as to enable the state and local health departments to organize properly and carry on malaria control measures wherever needed. This cooperative agreement for demonstrations in urban malaria control continued in effect until 1923. Under this agreement in 1920 one hundred thirty-three malaria surveys were made in urban communities and demonstrations of malaria control were conducted in forty-five. In 1921, 118 surveys and 26 demonstrations were made; in 1922, 96 surveys and 27 demonstrations were made. Thus each year from $250,000 to $350,000 was expended by the communities concerned and the contributing agencies for malaria control. These cooperative activities were of great assistance to the state health officials concerned by creating favorable public sentiment and thus making it possible for them to secure much needed appropriations for anti-malaria activities. The state health officers made the most of their opportunity and as a result every Southern state now has an organization for malaria control and funds which insure its continuation, whereas there was no specific appropriation nor definite organization for the control of malaria in any state health department of the United States at the time this cooperative agreement was entered into in 1919. The activities which were carried on under this agreement also had a happy influence upon the organization and development of county health work in the Southern states. Each demonstration was selected and planned to strengthen local health work and serve as a center from which malaria control would radiate over the entire county at least.

The co-operative agreement for urban demonstrations in malaria control was not resumed in 1923 because it was felt that the need of further demonstration in urban malaria control no longer existed and that such assistance as could be given to the state and local health authorities in the future by the cooperating agencies should be in the direction of rural malaria control and investigations. Such assistance has been freely given by both the U. S. Public Health Service and the International Health Board during 1923 to eleven state health departments and forty-five county health units located in ten states.

FUTURE MALARIA CONTROL IN THE UNITED STATES

In the light of the progress which has been made in the control of malaria in the United States as briefly sketched above, what prospect does the future hold that this disease will be banished from our borders along with yellow fever or exterminated to such an extent as to render it of no further sanitary importance? Before ridiculing the possibility of satisfactory control or complete eradication of malaria from the United States, let us consider some of the facts concerning malaria transmission in the United States and thus get a clearer perspective of future possibilities.

Malaria is a tropical disease and in every sense of the word is an exotic in the United States. It was brought to us, probably from tropical Africa. It does not belong here and does not flourish in the United States except in those localities which approach tropical conditions in temperature and humidity. (A narrow strip along the South Atlantic and Gulf Coasts extending further up the tributary rivers, particularly in the Mississippi Valley, also the river valleys of central California.) Outside of these limits endemic malaria is not found now except under abnormal drainage and subnormal living conditions.

During the past fifty years the area of endemic malaria in the United States has shrunk to less than one-third of its former extent without any effort on the part of health authorities to control this disease. There are still many localities in the United States which are capable of eliminating their malaria naturally and unconsciously as they become more prosperous. It should not be forgotten, however, that this process of natural cleansing becomes more difficult the closer trop-

ical conditions are approached, and, therefore, it cannot be expected that malaria will entirely disappear from the United States without properly directed effort on the part of the health authorities.

The public has been interested and is rapidly being educated in the principles of malaria transmission and the importance of malaria control. This movement began nearly twenty-five years ago, but has taken on greatly increased impetus during the past five years. Unfortunately those who need it most have least of it. As a result state health departments are now able to secure funds with which to carry out their programs of malaria and mosquito control.

State health departments in every state in which malaria is a serious health problem now have organizations with trained personnel and more or less adequate funds engaged in the control of malaria. In addition there are one hundred forty full-time county health officers in the Southern states where malaria occurs. Practically all of these full-time county health units have been organized within the past five years, and every county health officer who has a malaria problem is well aware of the importance of solving it. In view of the progress which has been made in the education of the people and the wonderful recent development of state and county health activities in the Southern states, it is not unreasonable to expect more rapid achievement in future malaria control in the United States than has heretofore been possible. I would not attempt, however, to venture an opinion as to how soon malaria will be controlled within our borders. This, of course, will depend upon many circumstances, such as: the future progress of education in disease prevention among the poorer classes, emigration from the Southern states and immigration into the Southern states, the solution of the negro problem with which malaria is inextricably intermingled, the energy and good judgment shown by the state and local health authorities in the grafting of malaria control on to their general health programs, economic conditions within the South during the next few years and the discovery of simpler methods of rural malaria control.

There are two aspects of the future of malaria control in the United States which appear to me to be of great importance and peculiarly worthy of your consideration. The first is this: we must not forget that our regular malaria fighting force consists of the state health officer and his trained personnel, and the county health officer and his health unit, the county health officer being on the firing line, with the state health officer directing, advising, assisting and providing a part of the sinews of war. Of course, there are volunteer forces, both private and public, which are available as reserves, but the brunt of the fight will fall on the county health unit. And since the state and county health officials have other health duties to perform for their people, it is unreasonable and unwise of us who are intensely interested in malaria to ask that the effort of these officers be directed entirely or disproportionately toward malaria control. Malaria control should take its proper place among the other activities of the county health officer. Any other policy would defeat or at least postpone the very object we have at heart. It is true that in many Southern communities malaria ranks first as a health problem and there it should be so treated. For the present it seems to me we should not expect the county health officer to do more than educate his people in the importance of malaria control, locate the foci of endemic malaria within his territory, check frank epidemics of malaria, call upon the state health officer and the reserves for technical advice in handling these problems and leave the individual, sporadic, doubtful cases, chronic malaria and traditional malaria to the general practitioner.

The other important phase of future control which I have in mind is the investigation of malaria within the United States. Our knowledge of malaria, malaria transmission and malaria control is based for the most part upon studies conducted in the tropics. Consequently we have been taught and are still inclined to think of malaria in the United States in terms of tropical malaria. We are apt to assume that where Anopheles quadrimaculatus is found in conjunction with human malaria carriers more malaria will inevitably follow. Apparently this is not always true outside of the tropics, whatever the case may be there. Certainly there are localities in the United States where anopheline mosquitoes are abundant, human carriers present, and yet malaria is of no serious sanitary importance. It seems, therefore, that too much importance cannot be attached to the thorough study of the factors other than anopheline mosquitoes and malaria carriers which enter into the transmission of malaria in the United States. Since 1913 the Bureau of Entomology has conducted a series of truly scientific investigations of malaria and malaria mosquitoes at Mound, La. Since 1915, the Bureau of Fisheries has studied the effects of top minnows on mosquito control. The Public Health Service began the investigation of malaria in 1912 and has never lost sight of the importance of the careful field study of many phases of malaria. During the past year the International Health Board has increased its activities in the investigation of malaria in the United States. It is believed that these studies have a most important bearing upon the future of malaria control in the United States and that through them we will be able to evaluate prop-

erly those other factors in malaria transmission which appear to have greater importance upon malaria prevalence in temperate zones than they have in the tropics and which may well furnish our health authorities with a simple key to future malaria control in the United States.

DISCUSSION

Dr. John A. Ferrell, International Health Board, New York, N. Y.—Within the past five years, as a result of education by means of demonstration and otherwise, more than $250,000 annually is appropriated for malaria control in the Southern states. This amount is as large as ten Southern states appropriated in 1910 for all public health work. The funds available have permitted the employment of from 50 to 75 workers, scientifically or practically trained, who devote their entire time to the control of malaria.

As was the case in combating hookworm disease, the methods employed in some instances may not have been so direct and so scientific as would have been possible had the work been preceded by extensive research. In the oldest and most efficiently managed business enterprises there continues to exist a certain amount of lost motion, and of course in new activities there is even greater lack of directness. Relatively speaking, the measures for the control of hookworm disease have been exceedingly effective, as has been shown by subsequent surveys. Counties which from 1910-1912 had from 70 to 90 per cent of their school children infected now show an infection of less than 10 per cent. It is more difficult to measure the amount of malaria in a community than is the case with hookworm disease. Consequently the measurement of progress in its eradication is more difficult. Malaria has undoubtedly been diminished as a result of the educational, agricultural, economic and social improvement in the malarious areas. Its eradication has been strikingly hastened by the control measures of the organizations enumerated by Dr. Fricks. As was the case in hookworm disease, we have found, in attempting practical control measures, that much additional knowledge is needed in order to give maximum results for each dollar expended.

The control of malaria is largely an economic problem. Density of population, wealth and drainage, which is essential to the cultivation of the soil, simplify the task. Many sections of the South, particularly those from which the timber has been removed and in which only small portions of the land are cultivated, present, from a malaria standpoint, a difficult problem which will probably not find prompt solution. The formulation of an economically feasible plan for such areas should engage the attention of our research workers.

The county health organization undoubtedly affords the proper basis for the establishment of machinery for dealing with malaria as well as other health problems in the towns, villages, and rural communities.

I fear there may be areas in the United States where malaria will remain a menace to health for many years to come.

Dr. C. C. Bass, New Orleans, La.—Most of us believe that we now see a tendency toward reduction in malaria. There may be an increase in one place and a decrease in another, but, on the whole, there is certainly a decrease. In the city of New Orleans we have not an amount of malaria of any consequence. Malaria is getting so scarce there that it is difficult to find enough to teach the subject as it should be taught in the medical school.

Another influence which Dr. Fricks mentioned and which I believe is sure to have its effect is the increased education of the medical profession to treat malaria cases properly to cure the infection. In most of the medical schools in the South, during the last four or five years, the medical students have been taught more than ever before the importance of curing the infection in the cases of malaria they treat. It is a long, slow process to reach doctors who graduated many years ago and who are "set in their ways," but if we can make good doctors for malaria of the young men now in our medical schools, it will mean a reduction in the number of malaria carriers and a decrease in the amount of malaria.

Dr. Fricks (closing).—The one obstacle to malaria control in the United States is our ignorant and therefore indifferent classes, both white and black. You recall the old Greek fable of Hercules and the giant Antaeus: Hercules wrestled with but could not throw Antaeus as long as he could touch the earth and renew his strength from time to time, but when Hercules lifted him bodily into the air the match was soon over. Just so long as our poorer people remain in the mire of ignorance, we shall be unable to do anything with them or for them. When we have county health units in every county and educate the people who need education, we shall conquer preventible diseases in the South.

THE SEASONAL INCIDENCE OF TYPES OF MALARIA PARASITES IN THE SOUTHERN UNITED STATES*

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It is well known that in the southern regions of Europe benign tertian is the predominant type of malaria parasite in the spring months of the year, and that estivo-autumnal, properly named the summer-autumn type, prevails in the later months. For this country but few figures have been published. Thayer and Hewetson[1] nearly thirty years ago published a short series showing that the benign tertian and estivo-autumnal types found in the vicinity of Baltimore followed by months much the same curve as that mentioned for southern Europe. Since the investigation of the seasonal variation in the types of malaria parasites may yield information of value to the study of the transmission and distribution of malaria it has seemed to us worth while to collect a somewhat larger series of figures for the whole of the southern United States.

In Table I are given the sources of our data, the number of cases from each source, the monthly incidence of cases and the percentage of benign tertian in the total positives of each month. Quartans and mixed cases are omitted. Only 18 quartans, about 0.3 per cent of the total, and 64 mixed cases, about 1.2 per cent of the total, were reported. The mixed cases, usually a mixture of benign tertian and estivo-autumnal, would only swell the totals of these types and would scarcely affect the percentages. In this table, then, as in all our charts and tables, we deal solely with microscopically determined positive cases reported as "unmixed" benign tertian or estivo-autumnal.

Having in mind the sources of error in typing malaria parasites, we attempted to diminish this

*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

TABLE I—POSITIVE CASES "UNMIXED" B. T. AND E. A. MALARIA AND PERCENTAGE OF B. T. = B. T. / E. A. + B. T.

Group No.	Source		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1.	Memphis, Tenn.	Number	8	8	18	39	56	63	218	400	355	269	80	15	1529
	U.S.P.H.S. Laboratory, 1918-1923	%B.T.	13	38	83	96	98	83	61	47	22	19	20	20	43
2.	Scott, Ark.	Number	26	23	24	50	88	140	280	312	427	314	124	27	1825
	J. K. and Dr. H. Thibault, 1911-1922	%B.T.	86	74	83	74	43	25	16	9	11	11	22	26	20
3.	Mound, La.	Number	4	0	5	11	14	26	43	198	62	65	17	3	448
	Dr. W. V. King, 1915-1917	%B.T.	50	0	100	82	85	65	35	21	21	9	6	0	27
4.	Mitchell County, Georgia	Number		16	18	16	9	12	6	27	34	35	1		174
	M. A. Barber, 1921	%B.T.		69	79	94	100	77	83	52	47	32	100		60
5.	Arkansas State Board of Health, 1921-1923	Number	6	10	8	11	27	26	69	74	76	74	20	19	420
	Dr. G. E. Davis	%B.T.	0	50	100	100	100	81	54	37	16	14	15	21	39
6.	Coahoma Co. (Miss.) Board of Health, 1923.	Number	2	3	10	19	27	34	69	25	11	32	15	17	264
	Dr. R. R. Kirkpatrick	%B.T.	50	67	20	37	82	94	100	72	0	13	13	18	61
7.	New Orleans, La.	Number	3	7	3	3	12	13	27	31	37	43	29	13	221
	Charity Hospital, 1918-1922	%B.T.	0	43	67	100	92	69	67	77	51	23	34	22	51
8.	Southwest Louisiana	Number	0	3	6	5	6	6	12	29	20	16	12		115
	M. A. Barber, 1923	%B.T.	0	33	17	100	100	83	58	79	80	38	42		65
9.	Texarkana, Ark.	Number	0	0	0	3	2	7	21	5	13	11	3		65
	St. Louis S. W. Railroad, 1922-1923	%B.T.	0	0	0	100	100	71	50	60	38	18	0		46
10.	Savannah, Ga., City Laboratory, 1923.	Number	0	0	2	0	2	1	8	1	6	10			30
	Dr. V. H. Bassett	%B.T.	0	0	100	0	100	100	63	0	0	10			37
11.	New Orleans, La.	Number	3	4	4	1	0	4	7	15	8	4	8	3	61
	U. S. Marine Hospital, 1922-23 (1 year)	%B.T.	33	75	75	100	0	100	56	33	36	0	75	0	50
12.	Southeast Missouri,	Number	42	0	25						6		6	29	108
	1921-1922	%B.T.	21	0	48						17		17	3	22
13.	Stuttgart, Ark.	Number								28	18	16			62
	M. A. Barber, 1920 and 1922	%B.T.								32	44	56			42
14.	Newton, Ala.	Number				24									24
	Dr. T. H. D. Griffitts, 1923	%B.T.				88									88
15.	Bolivar County, Mississippi	Number			483										483
	Bruce Mayne, 1915	%B.T.			34										34
16.	Bolivar and Sunflower Counties, Mississippi	Number													
	C. C. Bass, 1917	%B.T.	56	74	77	79	89	94	91	84	95	48	57	64	

error as much as possible by obtaining fairly large numbers (over 5000 positive cases were included) and by care in the selection of sources of information. In practically every group the examiners were known to us personally and known to be reasonably accurate. Reports of private laboratories and all reports in which the cases were only partially typed were omitted. Some series undoubtedly reliable were omitted on account of fewness of numbers. With the exception of a small group of cases from southeastern Missouri all our data were obtained from laboratories south of the thirty-sixth parallel.

In the Memphis laboratory the examination of smears was under the direction of Mr. Bruce Mayne and of Dr. William Krauss, and most of the slides were examined by Miss Mildred Moss and Miss Ethel Barrier, who also examined most of those collected in southeastern Missouri. Miss Moss also examined the slides obtained from the Arkansas State Board of Health. In the large group reported by Dr. Henry Thibault, the examinations were done by himself and by his brother, the late J. K. Thibault, Jr., whose work is familiar to many of you. The records of the St. Louis and Southwestern Railway were furnished through the courtesy of Mr. H. W. Van Hovenberg, Sanitary Engineer of that Company, and the examinations were done by Miss Edna Southard. Groups Nos. 4, 8, 10 and 13 were done by the authors personally. In the other groups the source of the data is sufficiently indicated in the table. We take this opportunity of acknowledging our obligation to those who kindly put their records at our disposal.

Whether the groups in Table I are large or small, the spring predominance of benign tertian and the autumn rise of estivo-autumnal are evident. An analysis was made of the positives obtained in each entire year's examination of all examiners. Twenty-five of these year groups contain fifty or more cases. In all of these 25 an autumn predominance of estivo-autumnal appears, and in 19 of them there is a spring predominance of benign tertian as well. The seasonal incidence of the different types is so well marked that it usually appears even in year groups of less than 50 cases.

In Chart I the data appearing in Table I are summarized. The curve is plotted according to the percentages given below the chart, each month's percentage being based on the proportion of benign tertian cases in the total for the month. The estivo-autumnal percentage is, of course, 100 per cent, minus the benign tertian percentage shown. The percentage of benign tertian is seen to reach its maximum in April and its minimum in October. There is a suggestion of a rise in November and December. All the groups of Table I are included in this chart except No. 15, which was omitted because the cases were distributed between two months, and No. 16, which lacked the monthly totals on which the percentages were based. In Group No. 16, a series made by Dr. C. C. Bass in Sunflower and Bolivar Counties, Mississippi, and including about 8000 positives, no particular attempt was made by the examiners to type cases. However, the seasonal incidence of types follows much the same curve as in our other groups.

In Chart II we have arranged our data in a different form in order to show quantitatively the relation by months of the two chief types of malaria to total malaria. The position on the chart of total malaria, represented by the solid line, was determined by the ratio which the positive cases falling in a given month bear to the total for all months. On the line representing the "altitude" of total malaria for each month the quotas of estivo-autumnal (broken line) and of benign tertian (dotted line) were measured off. For example, 966/4982, or 19.4 per cent, of the total cases fell in the month of August, and the position of total malaria for that month is thereby fixed according to the percentages given at the left of the chart. Then, following the incidence of the two types of malaria for that month, 35.3 per cent of the "altitude" of total malaria is measured off and assigned to benign tertian, and 64.7 per cent to estivo-autumnal. The varying area covered by each type is thus shown throughout the season; that portion found below the dotted

Chart 1

INCIDENCE OF BENIGN TERTIAN MALARIA BY MONTHS

BOTH WHITE AND NEGRO CASES

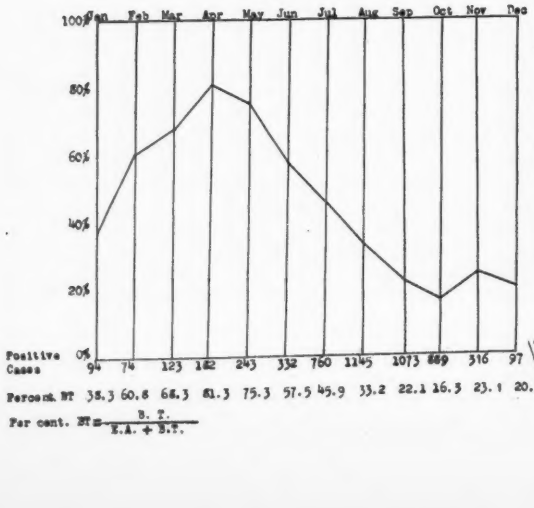
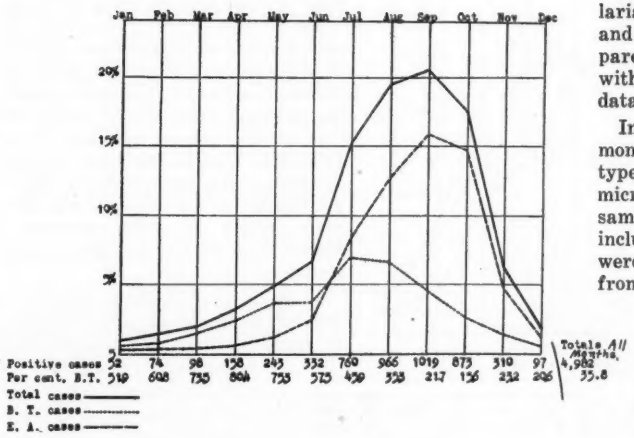


Chart 2

BENIGN TERTIAN AND ESTIVO-AUTUMNAL COMPARED WITH TOTAL MALARIA


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
20%
15%
10%
5%
0
Positive cases 52 74 98 158 245 332 760 966 1019 875 310 97
Per cent. B.T. 519 608 735 804 755 575 459 358 217 156 232 206
Total cases
B. T. cases
E. A. cases
Totals All Months 4,982
55.8

line representing benign tertian and that above it estivo-autumnal; or, the portion below the broken line estivo-autumnal and the portion above it benign tertian. Only typed cases are included in this chart, and all groups of Table I are included except Nos. 12-16, inclusive, and a part of No. 3, those groups being omitted because the data were distributed over but few months of the year, or because the monthly totals were not known.

In Chart II the incidence of estivo-autumnal is seen to follow closely that of total malaria. Benign tertian, on the contrary, appears to be diminishing during the period July-September, when total malaria is increasing. One must keep in mind, however, that many, possibly the majority of summer and autumn cases, which to the microscopist present a single type, may be mixed cases. A few parasites of benign tertian occurring among many estivo-autumnal parasites may be easily overlooked even if, as is rarely the case, the microscopist long continues his search after finding undoubted estivo-autumnal forms. As regards error in identifying parasites, we believe that estivo-autumnal rings are by the unwary more commonly miscalled benign tertian than the reverse case, an error which would go to unduly increase the benign tertian ratio, especially during summer and autumn when estivo-autumnal rings are most plentiful. However, taking into account all the imperfections of the microscopical evidence, a spring dominance of benign tertian, and an autumn dominance of estivo-autumnal parasite types are clearly shown; and whatever the proportion of mixed cases among apparently pure estivo-autumnals, the proportion of benign tertian parasites rapidly falls during the height of the malaria season.

The seasonal incidence of total malaria is an interesting thing in itself, and it may be worth while to compare the curve shown in Chart II with other curves based on different data.

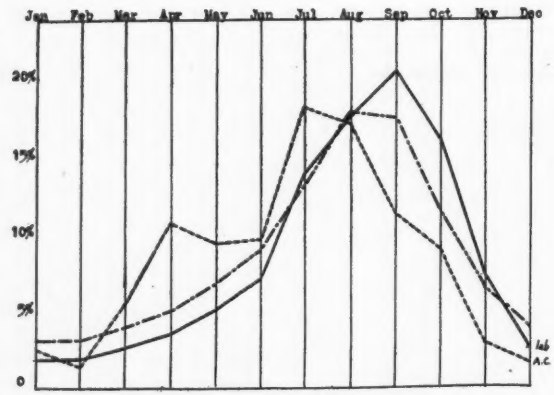
In Chart III, three other curves of monthly incidence of malaria of all types are shown. The one based on microscopical data is essentially the same as that shown in Chart II, but includes more cases, some of which were not typed. Of the two curves from clinical sources, that of the Army is less regular, possibly owing to the smaller numbers in it. All of these curves are constructed on the same basis as that of the curve of total malaria in Chart II, the ratio which each month's cases bears to the year total.

Noteworthy is the lack of a spring peak in any curve except the April peak shown by the Army figures. The type of parasite found in the Army cases is not known, but it is possible that this group included a large proportion of cases of benign tertian. If so, we would have a probable explanation of the April peak and of the early rise to the year maximum. In the reports of some of the laboratories there was a slight indication of a lesser spring peak, a phenomenon which usually disappeared in the aggregates of several years or localities. Spring peaks in the incidence of malaria have been reported from some localities in Europe. In this country they seem to be little marked.

In a general way our curves of total malaria show much the same seasonal incidence. Those of the microscopical evidence and of the Mississippi cases agree remarkably well. Von Ezdorf[2] obtained a very similar monthly incidence of cases and of deaths from malaria in certain Southern states.

Within the territory covered by our cases, latitude does not seem to be a prime factor in the seasonal distribution of types. Southeast Missouri gives a high percentage of estivo-autumnal. However, most of these cases fell within months when estivo-autumnal is dominant. From north of our territory we have records of 35 cases, microscopically typed, obtained from Nashville and Knoxville, Tenn.; Newark, N. J.; Pittsburg, Pa., and New York, N. Y., all of years subsequent to 1921. With the exception of one West Indian negro, all were be-

Chart 3.



MONTHLY INCIDENCE OF MALARIA (ALL TYPES).

Clinical, 3rd, 4th, 7th and 8th Army Corps, 1921-1922. 1,016 cases
Clinical, Reported to Miss. State Bd. of H. 1915-1922. 1,009,490 cases
Microscopical, Positives Reported by 11 Laboratories. 6,058 cases

nign tertian. Shattuck[3] reports 89 Massachusetts cases, part imported, of which 47 were benign tertian, 11 estivo-autumnal, and 31 undetermined. Sanford[4] reports 5 cases from Minnesota and Wisconsin, all benign tertian. Thayer and Heweston[1] reported 335 benign tertian to 188 estivo-autumnal, unmixed types, from Johns Hopkins Hospital, 1889-1894. These figures indicate that the benign tertian ratio increases as one passes northward in this country. A similar change of type with latitude is found in comparing northern with southern Europe and northern with southern India.

Professor Stanley B. Freeborn,[5] of the University of California, and Dr. L. H. Briggs,[6] of the University of California Medical School, sent us records of 283 cases, all, or practically all, of white patients. Their figures indicate clearly that the types of malaria parasite in northern California follow essentially the same seasonal curve as that of the southern United States, the maximum percentage of benign tertian appearing in the period February-June and the maximum estivo-autumnal in September, October and November.

An important factor must be considered in comparing ratios from different localities, the relatively high incidence of estivo-autumnal in negro positive cases, a fact first brought to our attention by Dr. Henry Thibault. In Table II the incidence of benign tertian is shown for whites and negroes in ten different groups. It will be noted that not only in the total but also in every group, large and small, the proportion of benign tertian in negro positives is less than that in white, the difference being very marked in plantation groups Nos. 2 and 3.

In Chart IV the incidence of benign tertian among white and negro cases is compared by months. The same groups are included as in Table II with the exception of that of Dr. Thibault, which was omitted because the monthly incidence of benign tertian among negroes was not known. It is clear that the seasonal variation in types is the same in white and negro positives, but the incidence of benign tertian in white patients is higher than that of negroes in every month.

In attempting an explanation of the greater incidence of estivo-autumnal in negro positives two factors should be considered: (1) negroes are as a rule more exposed to infection than white people. Estivo-autumnal is commonly considered the most readily transmitted type during the warmer months of the year. It will be noted in the chart that the negro curve has the more rapid fall in benign tertian, or, in other terms, the more rapid rise in estivo-autumnal. (2) Negroes generally receive less antimalarial treatment than white patients, and estivo-autumnal is commonly considered to be the more easily eradicated type.

Estivo-autumnal is by far the most common type of malaria in certain regions of Africa, but sufficient evidence does not exist to show that negroes in this country have any purely racial predisposition to this type of malaria. Probably any race of people living under similar conditions would show an equally high incidence of estivo-autumnal.

It is evident that the percentage of a given type of malaria in any group of cases from the southern United States will depend not only on the time of the year when specimens are taken, but also on the proportion of negroes in the group. These cases included in Table II show nearly two cases of estivo-autumnal to one of benign tertian. With the exception of those in one or two small groups, cases are well distributed throughout the year, but negroes form over 54 per cent of the total. Our group, then, while probably fairly representative of the larger river valleys of the South, may have a larger proportion of estivo-autumnal cases than the Southern states as a whole.

In discussing the cause of the spring rise in benign tertian and of the autumn predominance of estivo-autumnal, several considerations must be kept in mind:

TABLE II—INCIDENCE OF BENIGN TERTIAN MALARIA, WHITE AND NEGRO, ALL MONTHS

Group No.*	Source	White		Colored		Both Races	
		Positive Cases	Percentage of B. T.	Positive Cases	Percentage of B. T.	Positive Cases	Percentage of B. T.
1.	Memphis, 1918-1923	984	49.7	545	29.7	1529	42.6
2.	Thibault, 1911-1922	431	56.8	1408	8.4	1839	19.7
13.	Barber, Arkansas, 1920 and 1922	27	63.0	35	25.7	62	41.9
4.	Barber, Georgia, 1921	88	84.1	84	36.9	172	61.0
8.	Barber, Louisiana, 1923	96	66.7	19	57.8	115	65.2
7.	Charity Hospital, New Orleans, 1918-1922	165	55.8	56	35.7	221	50.6
9.	St. Louis S. W. Railroad, 1922-1923	38	60.5	28	25.0	66	45.5
11.	Marine Hospital, New Orleans, 1922-23	56	50.0	5	40.0	61	49.2
3.	King, Mound, La., 1915-17	167	43.7	273	17.2	440	27.3
10.	Savannah, Ga., City Laboratory, 1923	27	37.0	3	33.3	30	36.7
	Totals	2079	53.1	2456	16.5	4535	33.0

*Groups and numbers correspond to those of Table I.

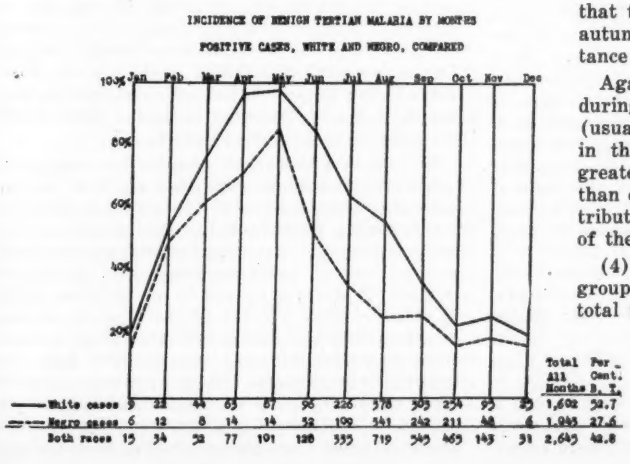
(1) Probably many cases of apparently pure types are mixed.

(2) It is generally agreed that benign tertian is more resistant to treatment than estivo-autumnal, and the type most likely to survive during cooler seasons or in cooler climates. A number of papers have been published on relapse in groups of soldiers infected in southern Europe or in Asia Minor during the World War. These cases, when brought to a region free from chance of reinfection, usually exhibited benign tertian in spring relapse, even when they were known to have been carriers of estivo-autumnal during the preceding autumn. The majority of these cases were kept in a cooler climate and under quinin treatment, and it is presumed that the original estivo-autumnal cases really harbored both types of parasites, and that the more resistant benign tertian alone survived treatment and any anti-malarial influence of climate.

(3) In the estivo-autumnal type gametes are more abundantly formed in the patient and persist longer, so that this type, once started in summer, tends to spread more rapidly than benign tertian. Possibly also the higher temperatures favor the development of the parasite in the mosquito more in the case of estivo-autumnal than of benign tertian. Lower temperatures are said to be better tolerated by the benign tertian type.

In certain of our groups, for example Nos. 2 and 3, Table I, cases from a given territory were examined by the same examiner or by the same laboratory over a period of years, and year may be fairly compared with year. If we compare the ratio of estivo-autumnal in positive cases with the prevalence of malaria as shown by the percentage positive of numbers examined, we note, in any group, a tendency for the estivo-autumnal ratio to rise as total malaria rises. Conversely, the benign tertian ratio tends to rise on years when total malaria is less than the average. This correlation does not appear in all years nor in all seasons of the year. Usually estivo-autumnal shows a high late autumn ratio whatever the malaria rate, but the correlation is sufficiently marked to indicate that the high transmissibility of estivo-autumnal is a factor of some importance in the total malaria rate.

Chart 4


INCIDENCE OF BENIGN TERTIAN MALARIA BY MONTHS
POSITIVE CASES, WHITE AND NEGRO, COMPARED
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
100%
80%
60%
40%
20%
Total All Months
Per Cent. B. T.
White cases 9 22 44 65 87 96 226 378 303 254 93 29 1,602 52.7
Negro cases 6 12 8 14 14 52 109 541 242 211 48 6 1,945 27.6
Both races 15 34 52 77 101 128 335 719 545 465 143 35 2,545 42.8

Again, with the increase of malaria during or following the rainy season (usually the mosquito-breeding season) in the tropics, there is generally a greater increment of estivo-autumnal than of benign tertian, a rise usually attributed to the greater transmissibility of the estivo-autumnal type.

(4) The estivo-autumnal rate in our groups follows closely the incidence of total malaria, and roughly the seasonal temperature curve.

(5) The estivo-autumnal rate also follows the curve of Anopheline prevalence, although not closely. Its maximum may be nearly five months later

than the time of appearance of large numbers of Anopheles, at least in the more southerly regions of the United States. It follows more closely the incidence of Anopheles quadrimaculatus than of Anopheles in general, although in southern Louisiana in 1923 Anopheles quadrimaculatus became plentiful nearly five months before the autumn drop in the percentage of benign tertian.

(6) It is possible that spring and late autumn conditions favor a greater gamete production in benign tertian than do those of the summer season, a thing not proved.

Two factors are probably of major importance in determining the seasonal distribution of types: (a) the more resistant character of benign tertian, enabling it to withstand climate or treatment and appear as the chief spring type; (b) the greater transmissibility of estivo-autumnal under summer conditions. The question arises as to whether we may admit another prime factor, that of seasonal relapse of estivo-autumnal. Part of the summer estivo-autumnal cases are, of course, continuations of spring and winter cases, but the question is whether any considerable part of the summer increment of estivo-autumnal is due to relapse of cases latent or appearing as benign tertian in the earlier months of the year. An opinion in general favor among students of malaria is that the summer and fall increase of estivo-autumnal is due to new cases almost wholly, that practically all the estivo-autumnal parasites die out during the winter and spring. Some evidence may be adduced, however, which gives color to the belief that some part of the summer and autumn estivo-autumnal may be due to seasonal relapse of this type. Stransky[7] reported on a group of 1700 soldiers infected in 1916 and removed to a non-malarious locality. The June incidence of estivo-autumnal was only 4.5 per cent, but rose to 49.8 per cent in November. During the same period the benign tertian percentage fell from 95.4 to 50.1. None of the men had been in a malarious region since May. Mietens[8] reported on a similar relapse of tertian in the spring and of estivo-autumnal in the autumn among a group of men not exposed to reinfection during the season. Hot climate and dysentery may have influenced the type of relapse. Nocht and Werner[9] reported on a group of railway workers removed to Germany after having been infected in Brazil. Of 90 cases of relapse the parasites were benign tertian in 56, estivo-autumnal in 15 and mixed estivo-autumnal and benign tertian in 19. In four cases tertian infection was followed by a relapse of estivo-autumnal. The men had suffered in Brazil from undernutrition and dysentery. Gill[10] had to do with soldiers infected in India and hospitalized in Muscat. The type of relapse was commonly estivo-autumnal, although the cases were receiving treatment and total malaria was decreasing. The author believes that the hot and humid climate of Muscat had some influence on the type of relapse.

The early disappearance of estivo-autumnal among cases removed from danger of reinfection and kept under adequate treatment may be the general rule, but the history of the groups just described would indicate that exceptions to the rule may occur, that estivo-autumnal may long continue to relapse, and that such relapse may be seasonal. Warm climate and intercurrent disease may also be factors in determining the type of relapse.

In this country our problem has to do with populations not removed to a new environment and receiving little or no systematic treatment. If practically all the summer estivo-autumnal increment is due to new infections, we should expect a marked decrease in the estivo-autumnal ratio in years during which the amount of total malaria is small. The estivo-autumnal ratio does tend to vary with the amount of total malaria, but the relationship is not a constant one, nor as close as we would expect if practically all autumn estivo-autumnal were due to new cases. In years of drought and in those following more or less extensive anti-malaria measures there may be a decrease in total cases, but we note much the same autumn rise of the estivo-autumnal ratio as in ordinary years. Thibault[11] reported on a series of cases from Scott, Ark., in which a marked increase in the proportion of estivo-autumnal and quartan appeared during the autumn of the droughty year of 1914, a year in which the general malaria rate reached a low level. In Mitchell County, Georgia, during a year following extensive quinin distribution, a dry year during which Anopheles were relatively few, the estivo-autumnal rate rose from practically zero in April and May to nearly 69 per cent in October. Freeborn[5] states that after certain antimalaria work in Anderson County, California, no cases could be found in the spring subsequent to the work, but that estivo-autumnal cases appeared in the following autumn. Presumably the autumn cases were relapses.

So long as a population remains in a malarious locality we cannot be sure that no new autumn infections take place, and the evidence given in the preceding paragraph has its limitations; but such evidence at least suggests that a part of the autumn rise of estivo-autumnal may be due to relapse. A decisive answer to our problem might be obtained from records of the type of malaria exhibited in a population migrated from a malarious to a non-malarious region. We have attempted to get definite information regarding the types shown by south Europeans and negroes migrated to northern cities, but thus far the evidence obtained from this source has been meager.

Any seasonal influence on the type of parasite in relapse would act through the patient. We know that not only debilitating factors cause relapse of malaria in a patient, but that exposure to sunlight or ultraviolet rays, change to a colder climate, exercise and various drugs may bring about a relapse. So it does not seem wholly improbable that certain climatic conditions, through their effect on the system, might tend to encourage one type or the other of malaria parasites in relapse, and such a factor, while perhaps not proved, may be admitted as a possibility.

Whatever factors we admit, the behavior of benign tertian in summer and autumn remains something of a puzzle. Benign tertian can certainly thrive in hot weather. It often occurs in the tropics and may form a considerable proportion of the cases found there. So its diminution in temperate regions even when total malaria is on the increase seems the more remarkable, especially when we consider the flying start it has in early summer. Certainly many cases apparently estivo-autumnal are mixed, but is the benign tertian in these mixed cases being propagated through the mosquito when parasites are so few as commonly to escape detection? When a carrier has sufficient gametocytes of benign tertian to infect mosquitoes we usually find an abundance of parasites. The cause of the seasonal variation in types of malaria parasite is apparently not a simple problem, and it is questionable whether we now have all the data necessary for its final solution.

Careful attention on the part of the microscopists to the type of malaria parasite will not only furnish records of value in the solution of theoretical problems, but will also afford material assistance to the health officer. Different types vary as regards relapse, resistance to quinin, and transmissibility, and the form of the seasonal curve or the proportion of the various types occurring in a given series may afford valuable information as to the success or failure of antimalaria measures. Certainly a group receiving intensive quinin treatment should show a fall in the estivo-autumnal proportion; and a very high estivo-autumnal rate, especially one long persisting, would indicate that new infections are common. In checking up results after an antimalaria campaign through blood examinations, indices should be made at various times during the subsequent season; at least a late summer or autumn examination should be made.

SUMMARY

(1) In the southern United States there is a marked seasonal variation in the types of malaria parasite, benign tertian reaching a maximum in spring and estivo-autumnal in late summer. Apparently benign tertian begins to decline while total malaria is increasing.

(2) The seasonal variation in types is marked in all latitudes from that of Memphis, Tenn., south.

(3) Negro positives show a higher percentage of estivo-autumnal than do white positives at all seasons of the year.

(4) The spring relapse of benign tertian and the rapid propagation of estivo-autumnal in summer and autumn are large, but probably not the only factors in the cause of the seasonal variation in parasite types. There is some evidence that there may be a summer and autumn relapse of estivo-autumnal due to the influence of season.

(5) A careful record of types of malaria parasite should be of material assistance to the health officer in judging of the results of antimalaria measures.

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DISCUSSION

Dr. C. C. Bass, New Orleans, La.—Dr. Barber's paper brings out the fact that there are many extremely important things about malaria that we do not yet know. We do not know at present the influences which cause the production of gametes, which make the carrier. We do know of certain influences that seem to have some effect, but no one is prepared to say why one individual develops large numbers of gametes and becomes a source of the disease to others, while other persons infected possibly from the same source never have any gametes.

Our information is incomplete as to those influences which cause the development of clinical symptoms and clinical relapse in malaria. We do not know at present to what extent and in what manner the seasons cause development of clinical symptoms, as they do.

Another thing that we need information about is the reason for relapse in infected individuals who migrate or move from one community or locality to another. It is a matter of common observation that when an individual who has been infected for a long time but who has not shown clinical symptoms for some time, moves to a colder climate, he develops clinical symptoms, whereas, if he had stayed at home, he probably would have had no symptoms.

Dr. Samuel T. Darling, International Health Board, New York, N. Y.—A seasonal incidence of tertian and subtertian plasmodia of much the same character was detected by me among patients in Ancon Hospital, Canal Zone, in 1909. It seemed to me that the increase of subtertian infections over tertian infections during the rainy season was due to the increased density of anophelines and to the greater length of time that subtertian gametocytes remained in the peripheral blood when compared with the corresponding period of tertian gametocytes.

The more abrupt fall in the incidence of benign tertian infections when subtertian infections are at their height might be accounted for by the tendency through fatigue to overlook tertian plasmodia in mixed infections after the search had revealed abundant subtertian plasmodia.

Mr. E. W. Kopf, Metropolitan Life Insurance Company, New York, N. Y.—The American Public Health Association, in its Section on Vital Statistics, has had a group working on public health climatology and it is precisely such data as Dr. Barber has offered that we are looking for. Dr. Fulton, Dr. Palmer and I, as members of this group, suggest that malaria data be studied by means of methods recently developed in the general field of public health climatology.

Seasonal variation is and has been one of the neglected aspects of morbidity and mortality stadirectly with the number of anopheles mosquitoes which are breeding in infected districts, and their numbers are in direct relation to the amount of rainfall. In other words, the wetter the season the more anopheles mosquitoes, and the more anopheles mosquitoes in malarial districts the more malaria we have.

Mr. W. H. W. Komp, Sanitary Engineer, U.S. P.H.S., Crowley, La.—I would like to discuss the point Dr. Darling brought out: that there is a tendency to diagnose cases occurring in the autumn as estivo-autumnal. Dr. Barber makes his own examinations, and in the period covered by this paper, three years, one in Georgia, one in Alabama and one in Louisiana, there is no error in diagnosis. Even if nothing but slides showing unmistakable crescents were considered, these show an absolute as well as a relative increase in estivo-autumnal malaria in the fall.*

*AUTHORS' NOTE.—In three of our groups with 1084 positive cases. (U. S. Public Health Service Laboratory, Memphis, 1923, 460 cases; Barber, 403 cases; New Orleans Charity Hospital, 221 cases) the examiners had noted crescents when they occurred, and these cases are tabulated below (Table III) according to months. The percentage which these crescent cases bear to each month's positives gives a curve very similar in contour to that of total estivo-autumnals (compare Chart I).

TABLE III—SEASONAL INCIDENCE OF CRESCENT CASES*

	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	All Mos.
Total cases	6	34	44	75	70	64	113	245	186	168	60	19	1084
Percentage crescent cases	33	27	14	5	3	3	6	11	17	9	27	5	11
Incidence total E. A. (Chart I)	62	39	32	19	25	43	54	67	78	84	77	79	64

tistics. Since data are now forthcoming in proper volume, it would seem desirable for your Subcommittee on Statistics to organize contributions similar to Dr. Barber's and submit them to qualified analysis. It is possible that cooperation could be established between your organization, the Vital Statistics Section of the American Public Health Association and the Hodgkins Fund of the Smithsonian Institution in further studies of seasonal and other climatic aspects of malaria in the Southern states.

Dr. W. E. Deeks, General Manager, Medical Department, United Fruit Company, New York, N. Y.—The incidence of malaria in the tropics depends more upon the number of mosquitoes than any other factor. We have had many examples illustrating this. In Cuba, in 1921, we had a great deal of malaria. In 1922 we had much less. In 1921, we had considerable rainfall. In 1922 we had very little rainfall, and consequently very few mosquitoes.

The tertian type of malaria has a wider geographical distribution than the estivo-autumnal. The tertian type seems more hardy and can survive in colder climates than the estivo-autumnal, as the former is found in latitudes further north than the latter. As a rule when we sanitate malarial districts the first type to disappear is the estivo-autumnal. The incidence of malaria varies

THE SPLEEN INDEX IN MALARIA*

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Notwithstanding the wide use of the spleen index in the Orient as a measure of malaria, the method has not met with general acceptance in the Southern states by the men who are making malarial surveys, and by those who are concerned in measuring malaria before and after the inauguration of control measures. In the Orient there is of course the language difficulty when working with natives, and this is an additional reason for having an objective method which will yield trustworthy results without having to rely on the testimony of ignorant, suspicious, overconciliatory or uncooperative persons.

Those concerned in malaria control must have some method for measuring malaria. Histories,

*Read before the National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

under the circumstances, are subject to considerable error. All native, subject, or dependent people are inclined to give the information which they believe the interrogator wishes to know. This is particularly true among negroes everywhere. Suspicious persons will deny that they have had the disease for fear that it is desired to sell them something. There is the difficulty of interpreting the statements of the persons. "Fever" may mean the fever associated with colds or it may, and frequently does, mean the spells of debility experienced by persons living in a warm climate. Again, even in heavily infected households, some members will give a straightforward history of chills and fever, while others whose blood may be positive at the time of the examination complain of headache and fever, or merely headache. Some persons may deny having any symptom of malaria, although their blood contains notable numbers of plasmodia. This is particularly true of native people long exposed to the debilitating effects of malaria.

In view of the difficulty of eliciting histories which may be relied upon, is it possible to gain the information desired by some other, preferably objective, method?

Malaria is not a disease which may be measured easily and accurately, for the reason that except when the plasmodia are present in the peripheral blood they secrete themselves in the recesses of the spleen and bone marrow where it is often impossible to detect their presence.

Manson long ago pointed out that malaria is a disease in which the phenomena in the peripheral blood represent merely an overflow while the tragedy is being played in the inner viscera. The overflow may be detected by an examination of the peripheral blood. When there has been segregation of parasites in the placenta they may be detected in that organ after delivery, as Clarke has pointed out. The marrow is not usually subject to examination nor is the spleen, but the latter organ undergoes enlargement during the infection and may remain enlarged for several weeks after the infection has subsided in the peripheral circulation. It is this organ which really shows the extent of the big "visceral happenings" in malarial infection.

Sydenham* had noted the relation of ague to swelling of the spleen, for he says:

"It is worth observing that when these autumnal agues have for a long time afflicted children, there is no hope of dispelling them until the abdominal region, especially in the neighborhood of the spleen, has begun to swell and harden, whilst in proportion as this symptom increases the ague goes off. Perhaps there is no better symptom whereon we may form a favorable prognosis as to speedy termination of the disease than the one in question. Observe it watchfully."

The English in India have been familiar with the association of splenic enlargement and malaria for many years. The earliest observation seems to have been made by Dempster. Later workers have used the spleen in measuring the amounts of malaria in different circumstances of age, race, geographical region and locality and as affected by season, rainfall, etc.

The most distinguished and experienced malarial epidemiologists who have worked in the Orient, for example, Ross, Christophers, James, Watson, Schuffner and Swellengrebel, are convinced of its great value. The method was used by the Uncinariasis Commission to the Orient in their efforts to measure malaria in the Malay Peninsula and Java.

At the Fourth Congress of the Far Eastern Association of Tropical Medicine assembled in 1921, a Committee was appointed to determine the most usable means of employing the spleen rate, rapidly and accurately, so convinced are they that it is a "precious asset" of the malariologist. Barber, Coogle and Maxcy have more recently used in the South a method of estimating the amount of malaria by ascertaining the proportion of school boys who had enlarged spleens.

In spite of the extensive use of the spleen census in estimating malaria little has been written on the rationale of the subject, nor have investigations been conducted to ascertain the limits of usefulness of the method.

It is to the latter subject that I have been led in my inquiries into malaria in Lee County, Georgia, where the International Health Board has established a laboratory to study certain field problems in malaria. The investigation is not completed and an analysis has not yet been made of all the data collected, but some of the more interesting points that have emerged may be mentioned at this time.

First, malaria is a constantly moving problem whether we contemplate the disease in an individual, in a community or in the infected mosquitoes which carry it from one person to another. Hence, it is not to be supposed that we can get a clear picture of the disease at rest, or that the rates or indices exist for longer than a short period of time. The cross section is constantly changing. In a large group of prisoners, which I studied in the Netherlands Indies, it was interesting to note the flux of relations within the group. The men were exposed to malaria night after night without any screening protection whatever. Spleen rates and blood rates were ascertained on several successive occasions. It was noted that the bloods of the prisoners became positive and then declined. Spleens en-

*Sydenham: The Works of Sydenham, Vol. 1, Medical Observations; chapter v, p. 50, Latham's Translation of Greenhill's Latin edition made for the Sydenham Society, London, mdcccxlviii.

larged to enormous size and later diminished in bulk. Hemoglobins in similar manner waxed and waned as the infection came under control as a result of the activity of the bodily mechanism of defense. It was remarkable that the prisoners as a whole who furnished the rates and who were constantly present in the jail yielded the same rates on the various occasions they were examined, but the individuals whose blood happened to be infected at the time of examination, or the person whose spleen happened to be enlarged, were not the same on each occasion. While the rate for the entire jail remained the same, the actual spleens and positive bloods were not the same. It is important to remember this because we must bear in mind that rates and indices and reports of positive and negative blood are only relative statements. Persons once infected with malaria may remain infected for years. These persons furnish the cases of malarial relapse. A person whose blood becomes negative should not be regarded as actually free from malaria. A negative report of a blood film means merely that no plasmodia were found during the time spent by the examiner on that particular film. A larger amount of blood might more readily show plasmodia. A negative blood or spleen does not preclude the presence in the individual of malarial infection.

THE RELATION OF MALARIA TO ENLARGED SPLEEN

The enlargement of the spleen in malarial infection is well known. Opportunity was obtained in the Orient to ascertain the manner in which this occurred in new infections and in relapse. Anophelines were experimentally infected with subtertian malaria and later the infection was induced experimentally in two men. After an incubation period during which the spleen could not be palpated, the patients became ill and at the same time the spleen became palpable and plasmodia appeared in the blood. After plasmodia had disappeared from the peripheral blood the spleen in one case remained enlarged for several weeks. The splenic reaction was more marked in the case that had had malaria previously.

The behavior of the spleen in relapse was observed in patients who were under observation in our wards and under treatment for hookworm infection. It was noted that when a relapse occurred the spleen, which had been perhaps of normal palpability previous to the relapse, became enlarged. After parasites had disappeared from the peripheral blood the spleen slowly returned to normal or to nearly its normal size.

The cause of the splenic enlargement is probably to be sought in the causes which lead to the segregation of defunct and infected erythhrocytes there, and to the phagocytosis of malarial pigment by splenic endothelium. There is an interesting correspondence between the appearance of plasmodia, the enlargement of the spleen, the diminution of hemoglobin and the reduction in the number of erythrocytes in the blood. As the spleen diminishes in size after the access of fever there is an improvement in the blood picture. The hemoglobin and the blood cells increase to normal numbers.

The enlargement of the spleen is due, then, in the first instance to the malarial infection and to the increased volume of injured and infected erythrocytes and pigment in that organ. Since the spleen enlarges during the attack and remains enlarged for some time afterward, the organ should be an important means of diagnosis of the infection when, as is often the case, the plasmodia have disappeared from the peripheral blood and have retired to the spleen and marrow. It is questionable whether the spleen does not become a more important means of diagnosis of malarial infection present and recently acquired than the blood picture and presence of plasmodia, for the enlargement of the spleen indicates the presence of plasmodia in the deeper viscera when they are not demonstrable by an examination of the peripheral blood.

The spleen may enlarge to enormous proportions in regions where the endemicity is high. Malariologists have been accustomed to using a rough estimate of the volume of the spleen as being palpable or enlarged to 1, 2 or 3 finger breadths below the costal margin, or even four finger breadths, or to the umbilicus or pelvis. These very large spleens are encountered among people who are underfed and habitually subsist on an insufficient ration. Their resistance is too low to enable them to reduce the infection promptly or properly. The classification of the spleen according to the different degrees of enlargement has a basis in the fact that there is a greater degree of malaria in the spleens of large size. In the Orient, where there exists an enormous population subsisting on an insufficient and unbalanced ration, where large masses of the population are habitually underfed, malaria produces, in conjunction with underfeeding, spleens of very large size. Oriental malariologists are so accustomed to these large spleens that they use coarse methods of detecting the degrees of enlargement in malaria.

In the Southern states, where there is less underfeeding and where those infected with malaria subsist on a more nearly balanced ration than Oriental people, the larger spleens will be less frequently encountered. Probably finer methods of detecting the degrees of splenic enlargement or a more delicate scale will have to be used in the South.

The following classes of spleens are being

tentatively used at the present time at our station:

(1) Negative on deep inspiration.

(2) Palpable on deep inspiration.

(3) Palpable on normal inspiration, but not 1 finger's breadth below the costal margin.

(4) One finger's breadth below the costal margin in normal respiration.

(5) Two finger breadths below the costal margin in normal respiration.

(6) Three or more finger breadths below the costal margin in normal respiration.

The Relation Between Degree of Splenic Enlargement and Malarial Infection.—A definite relationship exists between the size of the spleen and the amount of malaria as measured by the presence of plasmodia in the peripheral blood, and the spleens of the higher degree of enlargement are positively correlated with the presence of plasmodia in the peripheral blood.

It is seen that persons with spleens enlarged to the higher degree are more apt to have plasmodia in the peripheral blood than others, but it is to be noted that spleens of all degrees of enlargement are malarial, and the larger the spleen the more likely its possessor is to have plasmodia in his peripheral blood. Even the spleen that is only palpable on inspiration is as good as index of malaria as the spleen just palpable below the costal margin.

The spleen just palpable on deep inspiration is encountered in the winter after the malaria in the community and in the individual has subsided and it is found on plantations where the malaria is very light. It is, then, an indication of light or residual malaria.

Method of Examination.—In order to elicit these smaller degrees of enlargement and better to determine the exact degree of enlargement of any spleen, it is necessary to place the child in a recumbent position with the thighs and legs flexed. The clothing is loosened so that the hand of the examiner can be placed upon the bare skin of the abdomen in the region of the spleen, above and below the costal margin. The child is instructed to take a deep breath. With the tips of the fingers of the right hand held at and just below the costal margin, slight pressure is made just as the child takes a deep breath. Then if the spleen is enlarged it may be felt as it descends, being pushed down by the diaphragm. Care must be taken not to press too deeply or the margin of the spleen may be missed.

Spleens that are palpable or of the higher degrees of enlargement may be palpated without the necessity of the child's taking a deep breath, although, for the examiner to make a uniform comparison of all the spleens, it is necessary to have the child breathe deeply in every case.

The Class of Children to Include in the Spleen Index.—The spleen may be palpated more easily in children between the years of 2 and 12 than those younger or older. For this reason and for the equally important one that children, after the age of puberty, who have always lived in an endemic region, are less apt to have enlarged spleens than the younger ones, it is advisable to limit the children examined to those between the ages of 2 and 12.

It is the practice at our station in Lee County, Georgia, to examine the negro boys and girls at the school or preferably at the quarters on the plantation. At the latter place the smaller children can be found and the parents can be questioned and advised when we encounter cases that urgently require treatment. The plantation is the location of preference for another reason. Malaria is a local problem and, at the time the spleen rate is determined on the plantation, all the houses are searched for anopheline mosquitoes, which are dissected later to determine the sporozoite rate. The neighborhood within flight distance is also searched for breeding places. Thus a complete picture of the malarial environment is obtained. Malarial rates are therefore referred to the locality and not to a county or township or school. It is obviously more important to refer the rate to the actual locality than to merge it with others of a different type of locality having a different problem for control. White children are taken at the homes or the school, but the spleen examination of girls is conducted at their homes and not at the school. Perfect cooperation has been a rule. Negro parents have often washed their children and sent them to us cleanly and freshly dressed for examination. White mothers have brought their girls to homes where we have been engaged in examining the girls of other parents.

DEGREE OF SPLENIC ENLARGEMENT

	Negative Spleen	Palpable on Inspiration	Palpable	1 Finger Breadths	2 Finger Breadths	3 Finger Breadths
Total cases in group	338	51	126	29	30	23
Per cent with plasmodia in the peripheral blood	11.2	35.3	34.1	55.1	60.0	69.5

The Spleen Rates Found in Lee County, Georgia.—It is possible to analyze the rates obtained from some 30 plantations in Lee County, Georgia, and compare the spleen rates with the history rates and these with the endemic index or parasite rate. There are 571 histories which it is possible to analyze in this way.

Total cases with histories either positive or negative for malaria	571
Percentage of these giving a positive malarial history	37.4
Percentage with positive or enlarged spleen	40.8
Percentage with positive bloods	25.2

By the method employed it is seen that the spleen rate corresponds closely with the percentage of cases giving a positive history of malaria since the beginning of the year.

Twenty-one plantations yielded spleen rates from 15 to 89, while the endemic index or parasite rate of these same plantations ranged from 7 to 54. These rates were, for the most part, obtained during the spring and summer before the malaria had reached its height. In the re-examination now underway even higher rates are being found. As was pointed out above, most of these enlarged spleens are of the smaller degree of enlargement, although many were one finger's breadth below the costal margin on deep inspiration, which is definitely a pathological spleen. The number of spleens which were palpable on inspiration or merely palpable was 177 out of 592 examined, a proportion equal to 29.3 per cent. The spleens of a larger size or those one finger breadth and larger are 82 in number, or equal to a rate of 13.8 of the whole number of cases examined. The average spleen rate of these 21 plantations is 55.4, while the endemic index or parasite rate is 31.8. Taking the entire number, if the spleen rate is multiplied by the factor 0.57, it will yield the parasite rate. It would be possible, therefore, to derive a parasite rate from a spleen rate without the examination of blood when large numbers are taken. But, as we have already pointed out, the control of malaria is a local question and the rates should be referred to the locality and not to a larger artificial geographical unit. The spleen rate of the negro children of Lee County is about 40, but this does not give a fair idea of the distribution of the disease which is generally severe, though patchy, some plantations having a low rate and others very high.

DISCUSSION AND SUMMARY

A method of estimating malaria which is used so extensively by distinguished authorities in the Orient must possess a usefulness in the Southern states if measurable malaria exists in the latter region.

Malaria is a disease the phenomena of which take place not only in the peripheral blood, but, to a greater and more prolonged extent, in the internal viscera, notably the spleen.

Among the negro children examined in Lee County, Georgia, there is a measurable correspondence between the degree of splenic enlargement and the amount of malaria as measured by the occurrence of plasmodia in the peripheral blood. That is to say, the larger the spleen the more apt is one to find plasmodia in the peripheral blood.

All degrees of enlargement are indicative of malaria. Even the smaller spleens show more evidence of the presence of malaria than the spleens which are entirely negative upon the most careful examination. The examination can be carried out on the children between the ages of 2 and 12 wherever it is convenient, at the plantation or school, but in each instance the spleens should be referred back to the locality of origin by ascertaining the residence of the subject. In this way the spleen rate becomes an accurate reflection of the amount of malaria in the immediate environment of the children examined.

The time required to ascertain the spleen rate is very much less than that required for history taking and for taking blood specimens and the results are obtained immediately without the necessity of waiting for the examination of the blood specimens.

When the spleens are classified and the results of the census are expressed in terms of spleens of different sizes, there may be less diagnostic error involved than when either histories or blood examinations are used. The more refined the method for detecting even the smaller degrees of enlargement the more accurately may the amount of malaria be determined.

This is of course true of any clinical method. If it is desired to ascertain with great accuracy the amount of malaria, then the most accurate method will have to be used. Epidemiologists will have to determine what degree of accuracy they will need for their purposes.

At the present time the results of different observers will show certain discrepancies although they agree as to the general prevalence of malaria. Malariologists in the Orient encounter many examples of greatly enlarged spleens in the undernourished and severely infected natives of those regions, and they use methods which are too coarse to detect the finer degrees of enlargement to be found in regions such as the South, where there is less underfeeding and generally less severe malaria than in the Eastern countries.

From the observations taken so far in Lee County, Georgia, it can be stated that the spleen index appears to afford a very sensitive, accurate and easily applied method of detecting present and recently acquired malaria. It will detect the cases of malaria acquired the previous season, which furnish the chronic carriers of the disease,

in which the blood is sometimes negative. It is these carriers which infect Anophelines in the following spring and summer and give rise to epidemics or to seasonal endemicity. The spleen census rests on a malarial basis, and because of the larger numbers involved will probably furnish a more sensitive measurement of malaria than the blood index. Its accuracy and trustworthiness depend upon the examiner and not upon the testimony of an ignorant, careless or otherwise unsatisfactory subject. For this reason it may become the method of preference over that of the clinical history or of blood examination, which latter mode is more objectionable to children and the most difficult to carry out.

DISCUSSION

Dr. K. F. Maxcy, U. S. Public Health Service, Montgomery, Ala.—Two years ago the United States Public Health Service undertook to make investigations along this line. Dr. Darling's work has been intensive and qualitative, while ours has been extensive and quantitative. We wanted to find out, in the first place, if the spleen rate could be applied in different parts of the United States, and, in the second place, if it could be used as an index of the amount of malaria present.

It makes a great difference at what time of the year the examinations are made. For reasons which are obvious we chose the winter months. The period of transmission in the United States is considerably shorter than in the tropics. Outside of July, August and September there is little transmission going on. During the winter months we should expect less variation in the spleen rates than during the summer months. This consideration is particularly significant in dealing with so small a unit as a plantation. For instance, you might visit a plantation just before an outbreak of malaria, or during one, and obtain widely different spleen rates.

We chose the school unit because of its practical availability. It has its drawbacks, but also has its advantages, one of which is that the school unit is present everywhere, while the plantation unit is not. In large parts of the South the plantation system is no longer in existence.

The disadvantage is that the school may draw from a fairly large area, particularly if it be a consolidated school. There may be one particular locality in this school district which is heavily infected with malaria, while the remainder of the district is relatively free. In such a case, the per cent of positive spleens seems small, being diluted by the negatives from the malaria-free neighborhoods. The per cent of enlarged spleens in a school group may be low, therefore, in the presence of a small, badly infected neighborhood.

The third point was the question of whether we should include the girls along with the boys. Inasmuch as the method is simply an index, and we are selecting a population group anyway, and since we have, at present, no information as to any difference between male and female as regards the incidence of malaria, we chose boys of school age as our population group.

The fourth point was whether the children should be examined in dorsal decubitus, or standing. Because of practical advantages under field conditions, we decided to use the standing position. The patient was bent slightly forward, with the abdominal muscles relaxed, breathing deeply, and the palpating hand was next to the skin, for routine. We checked doubtful results by a subsequent examination with the patient lying down. It is our impression, from a rather large experience, that we do not miss many of the definitely palpable spleens on account of the method when once skill has been attained in using it. Both methods are used by tropical workers and their relative reliability is a mooted question.

Another question was this: if we are going to use spleen rates to determine malaria, we want to make the results as nearly comparable everywhere as possible. We want to use a method that requires ordinary skill and not a method that requires excessive skill; one that could be used by any county health officer. In other words, if there is any variation in results when two individuals go over a group of spleens, it is in the barely palpable spleens which one man can feel and the other cannot. For that reason we decided to record only the spleens palpable beyond all question of doubt. The results we have obtained so far should be considered in the light of that point of view and that method.

The work already done has shown conclusively that in certain areas in the United States where malaria is highly prevalent the spleen rate of school boys taken during the winter months is sufficiently high to be of value in an index. In other areas, lightly infected with malaria, this does not hold true. It is impossible to predict what will be found. The experience gained in one area may be contradicted by the findings in another, apparently similar. For example, we were very much surprised to find a spleen rate of about 3 per cent in a group of 212 children on the plantations at Mound, La., when the parasite index was close to 12 per cent, while a group of 426 colored boys in the Mississippi Delta, taken from January to April, 1923, showed a spleen rate of 13 per cent and a parasite rate of only 6 per cent.

It is not unlikely that the local demand for quinin and quinin containing nostrums in this country is responsible for differences in the spleen rate, as has been suggested many times before. That our rates are considerably lower than those found in tropical countries is also not strange in view of the fact that in the southern United States the period of active transmission of malaria is only three to four months and the infected persons have eight or nine months in which to recover, whereas in many tropical countries it lasts throughout the greater portion of the year and the population has little respite from new infections. There are many other factors which differ.

However, the fact remains that the spleen rate is sufficiently high in many parts of the southern

United States to be valuable as an index and it should be utilized more than it has been in the past.

Dr. Darling (closing).—These figures are based on negro children, a large number of whom had taken a little quinin in the form of chill tonic, but in insufficient quantity to affect the disease.

ANOPHELES INFECTION UNDER NATURAL CONDITIONS*

By W. V. KING,
United States Bureau of Entomology,
Mound, La.

The results of a study of Anopheles infection made by the writer in 1917 have been previously reported.[1] The specimens which were examined for malarial parasites during that year were collected in the vicinity of Mound, La., and on the State Penitentiary farm at Parchman, Miss. Several thousand examinations were made, but of the mosquitoes collected at Mound the majority were taken during the non-malarial season, and on the state farm at Parchman conditions were not representative of farming conditions generally in the locality under investigation. It was therefore considered that the results obtained did not furnish a great deal of evidence as to the normal rate of infection. With the assistance of the International Health Board, the studies were again taken up at Mound in 1921, and were continued through 1922, when it became evident that the number of naturally infected specimens to be found was very small. The findings for the latter year were of especial interest because they were coordinated with studies of the blood-feeding habits of this genus and their normal abundance about the dwelling houses.

For the purposes of the combined study a representative number of houses, distributed over three large cotton plantations, were selected and each month during the season complete counts or collections were made of all the Anopheles to be found resting about the buildings during the daytime. Samples of each of these collections were taken for dissection and examination for malarial parasites, and other specimens were kept for determination of the host species upon which the mosquitoes had fed, these determinations being made by means of the precipitin method of identifying blood as described by Bull and King.[2] From all of these records averages were obtained which gave the approximate numbers of Anopheles which visited the tenant houses and obtained blood meals, the proportion which had fed on members of the tenant families and the number which contained the infective stage of the malarial parasite.

In the previous dissection work both stomach and salivary glands had been examined in determining the infection of the mosquito. During 1922, however, in order to increase the total number of dissections, the examinations were confined largely to the salivary glands, since it was more desirable to find as many as possible of the specimens which contained the sporozoite stage and were therefore capable of transmitting the infection at the actual time of capture. The specimens for dissection were brought to the laboratory alive and, as it was often a week or more before the dissections were made, the majority of them were placed immediately in an ice box to prevent further development of the parasites, except that the ones in which the stomachs were also to be examined were kept at room temperature for three or four days to permit digestion of the blood meal.

Exclusive of a few special collections which are omitted from the final averages, the total examinations of Anopheles quadrimaculatus during 1922 were as follows:*

Number of stomachs examined	2365
Number with oocysts	14
Number of salivary glands	9340
Number with sporozoites	10
Sporozoite rate	0.107%

The stomach examinations were from specimens which were collected almost entirely inside the houses and the rate obtained for oocysts is undoubtedly higher than would have been the case if mosquitoes from all locations had been included. It was considered, however, that the matter of location from which the mosquitoes were obtained would have little or no effect on the number of gland infections found because of the length of time elapsing between the infective blood-meal on a gamete carrier and the final development of sporozoites, there being little likelihood that the mosquitoes would remain in the same room or building during that interval. That this is true is borne out by the finding of infective mosquitoes in all of the principal locations in which the Anopheles were resting, as may be noted from the following:

Location	No. Glands Examined	No. with Sporozoites
Inside houses	2129	2
Under houses	3720	5
In stables	2002	1
Other buildings	1489	2

Such differences as do occur in the above records are of little significance because of the small number of positives. For the same reason, little

*Read by title before the National Malaria Committee (Conference on Malaria), meeting conjointly with the Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1924.

*I am much indebted to Miss Gertrude Gideon and Miss Gertrude Barrier for assistance in the dissections and examinations.

information was to be derived from the data as to seasonal occurrence of infections or the probable variations on the different plantations. Two positive glands were found in June, four in August and four in October. Of the three plantations Killarney, with the lowest malaria and mosquito averages, gave two positives, Hecla three and Algodon five, with differences occurring in the number of specimens examined from each place.

An infective rate among the mosquitoes of only about one per thousand appeared to be very low for a locality in which malaria is prevalent. The proportion found to have fed on human blood was also low, the general average as determined by the precipitin tests being but 4.3 per cent.[3] It is, therefore, of considerable interest to estimate the effect of these rates when taken in connection with the abundance of mosquitoes in the locality.

The following averages were given and discussed in the article referred to above. They apply to 39 places distributed over the three plantations and the daily average for female Anopheles is for the five-month period from the first of May to the last of September.

Average daily number of female Anopheles per place	779
Per cent freshly fed (i. e., fed previous night)	45.0
Per cent feeding on man	4.34
Number fed per person during season (153 days)	575

It is evident from this that the low biting and infective rates are offset by the high mosquito density. With 0.107 per cent of the mosquitoes infective, but with each person receiving an average of 575 bites during the season, 61.5 infections per hundred people would be expected. As some of them would receive more than one infective bite, the number of individuals becoming inoculated would be something less than that figure. In a population large enough for normal distribution to be approached, the probable number of infections resulting from these conditions may be estimated by means of Poisson's "Law of Small Chances," which gives the following percentages: 33 per cent inoculated once, 10 per cent twice, 2 per cent three times and 0.3 per cent four or more times—a total of about 46 per cent of the population becoming inoculated during the season.

It should be pointed out that these estimates do not cover the entire active season of Anopheles. We have used the five months from May to September as the average season and the great majority of mosquitoes do occur during this period. It is also true that Anopheles are to be found here in April, October and other months, so that transmission is not limited to the time for which the estimates were made. It is a common observation that cases of malaria develop late in the season, and several of the infective mosquitoes in my series were found in October. However, there are other evident factors that enter into such an analysis as attempted here, some of which tend to reduce the averages obtained, others to increase them, so that an effort to correct for these without additional data seems of doubtful value.

One point which seems to be emphasized by the results of the study is that a large mosquito population is required to produce a high malarial rate under the conditions existing in this locality. That the amount of malaria acquired by the residents is not, however, altogether proportional to the number of mosquitoes present was an interesting fact brought out by the blood identification work. As the number of Anopheles about the houses increased there was a decided drop in the proportion which had fed on man. By taking the average in various groups according to the abundance of mosquitoes, 6 to 8 per cent were found to contain human blood where the average per house was from two to five hundred or so, but decreased to 3 per cent and less when the average reached 1500 or more. It is apparent that the tendency of this, as regards opportunity for malarial transmission, would be greatly to reduce the effect of a high mosquito infestation, while from a practical standpoint, if this fact proved to be a usual feature of Anopheles biology, it is readily seen that a considerable proportion of the mosquitoes might be eliminated, where they were very numerous, without proportionally reducing the number which succeeded in biting man and inoculating him with the parasites of malaria.

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DISSEMINATION OF MALARIA INFORMATION*

Dr. W. S. Rankin, State Health Officer, Raleigh, N. C.—The most important phase of public health work has been and I presume will always be the dissemination of information, that is, the educational work of boards of health. As long as we have to deal with a democratic people they will have to be led, not driven. Another thing about the relative importance of the educational work of health departments is this: if you try to figure out how much a man does that he is made to do, that he is required to do by law, and how much he does of his own volition, how much of health is purely an individual matter and how much is a civic matter, you will find that most of the things the individual does are for indi-

*Round Table Discussion, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

vidual and not for civic reasons, and are things he is not made to do.

When it comes to educating the people in regard to malaria, we may consider the usual methods that we have developed so far, to wit: public health literature, bulletins, pamphlets, newspapers, films, moving pictures, and, lastly, the house-to-house work through nurses and the visits of the physician. It has been always an interesting problem to try to estimate the relative importance of educational work carried on through pamphlets and bulletins and newspapers that reach the small per cent of the population who read, and the importance of the information disseminated by the house-to-house method. Of course, through the newspapers you reach perhaps two-thirds of the people. The ordinary county paper that is well edited and has a rather favorable reception through the county, reaches perhaps one-sixth of the homes. Certainly the distribution of health literature would reach even a smaller per cent of the population. So, taking public health education through the newspapers, we reach a rather discouragingly small per cent. But, on the other hand, we have to remember that we reach the relatively important part of the population. I do not know that it makes so much differenee what the 99 per cent do, anyway. It is the few people of influence whom you can count on your fingers who will determine what the herd will do. So when we consider the relatively small per cent reached by pamphlets and newspapers we should not be too much discouraged. They make up by the quality of their thought what they lack in number.

But in work like this, where so much depends upon the individual himself, whether he takes quinin, whether he has his family take quinin, whether he screens his house, the information that is disseminated will probably have to be through more popular channels, particularly through house-to-house visits of nurses, and also through films. Our industrial population and a large part of our agricultural population do not go to hear lectures any longer. They go to a moving picture if they have time for anything like that, and they are getting so that they are not entertained except by high class films. I believe the film is a great educational method.

I believe most of the educational work on the problem of malaria will have to be done, as with the other important problems of hookworm, infant hygiene, tuberculosis, etc., by public health nurses, in house-to-house visits. You cannot reach these people by the printed word. You cannot always reach them by the moving picture. You cannot reach them yourself, but you can get to them through the nurse who comes in contact with them. We are coming more and more to recognize the large place that the public health nurse will take in the house-to-house work in malaria.

Dr. B. B. Bagby, Henrico County, Richmond, Va.—I have found that my best way of getting knowledge to the people is through the churches. I had a case of diphtheria a few weeks ago in a community. I went to two white churches in that vicinity and told them I had diphtheria, explained the methods by which I hoped to control it, and advocated giving vaccinations. Two local physicians told me that from those little talks which I gave they had each vaccinated twenty-five children. I believe seventy-five children were vaccinated in a few days as the result of the two talks. It is the best people that you want to reach, and I believe almost invariably the best people will be found in the churches. I begin by telling them that I do not have to apologize for giving a health talk on Sunday for when our Lord was here He healed the sick on Sunday. I believe that if you go to the colored churches and give the people there a simple talk you will accomplish more than in almost any other way.

Dr. Leon Banov, Charleston, S. C.—It seems to me that Dr. Rankin failed to stress a very, very important element in our program of disseminating knowledge. He neglected to state the importance of educating the coming generation, the school children. In our county we lecture periodically to public school children on the subject and ask that every child submit at least one composition during his school life on malaria. We give annual prizes for the best essay for the year. We can impress these children at an age when they will retain the impressions.

Dr. L. L. Williams, Jr., U. S. Public Health Service, Richmond, Va.—In the State of Virginia the school course is considered the most important thing the State Department is doing in the line of educational propaganda. We have a good ten-hour course.

Moving pictures play a large part in the work, especially in the country districts. You will find that you can buy a cheap make of automobile roadster, a small Delco light plant or one of the other lighting outfits, a portable moving picture machine and a reel on malaria, all for about $1300. It will last for about eighteen months, traveling as it does over very bad roads. A young man, possibly a high school boy of about seventeen, can learn to operate the machine very readily. This outfit will go from county to county and give six shows a week, except when it is being moved by its own power from one county to another. We use either schools or churches, and we have never had either refuse us the use of the building for health pictures on any night. You will be surprised at the number of people who come out. I remember in the old days quite a few people would come out to lectures; then they stopped coming. They would come to lantern slides formerly, but they stopped that, too. It seems that the moving picture is at its high tide now, and we should certainly take advantage of it. In some country schools where we showed the pictures there were only half a dozen houses in sight, but the people came from miles around and packed the school house or church to see the pictures. This disseminates the information and in many instances leads to the organization of county health work.

There are a number of good malaria reels to be found which may be purchased at from $75 to $90. If you want to put local interest into your

films, it is not very expensive to make a film in your own community, as was done in one place in Virginia with conspicuous success.

Dr. H. H. Howard, International Health Board, Jackson, Miss.—The problem of educating the people with regard to malaria is quite different from that of educating them about some other diseases. As we understand malaria, it presents a rather complicated problem to the lay mind. I had the opportunity of showing a malaria film issued by the International Health Board and of observing the results of the film's being shown by questioning school children who had seen it with no accompanying lecture. To my surprise and gratification I found that some of the finer points of malaria control and the facts regarding the disease which we wished to communicate to the lay mind were intelligible and were intelligently commented upon by the children. It is very easy to interest average people in a rural community in a moving picture. They do not see one often, and will drive miles for the purpose. We are just beginning to realize the importance of films in malaria and other health work.

Dr. Oscar Dowling, State Health Officer, New Orleans, La.—We find in Louisiana that films draw very well, but some criticism on local conditions attracts more attention. People want to know what you are going to say about Tom Jones' dairy or John Smith's pond.

With the assistance of the United States Public Health Service four or five years ago we did some work in a town, but were unable to keep it up. A few days ago one of the men connected with an industrial plant told me that the time lost through malaria was costing enough for them to be willing to pay half the cost of a public health official for that town.

Dr. S. W. Welch, State Health Officer, Montgomery, Ala.—In Alabama the School Board adopted a new text book on physiology and public health. The members of the Health Department collaborated with the members of the School Department and wrote a public health supplement to the text book which was adopted in the schools, and part of the curriculum now of the public schools of Alabama is this supplement on public health.

BIOLOGIC INVESTIGATIONS*

Dr. F. W. O'Connor, International Health Board, New York, N. Y.—I wish to take up two subjects, the animal barrier and the resting place of Anopheles quadrimaculatus.

The animal barrier: those who believe in the use of animals as a barrier between mosquitoes and man have attributed to this measure, in some instances, the disappearance of malaria from areas where it was formerly prevalent; while those who oppose the "barrier theory" state that the introduction of animals amongst the community does not cause any decrease in mosquito numbers or malarial prevalence. The following two examples will illustrate how the introduction of animals near the vicinity of man may affect mosquito numbers under different conditions:

At Byne, Lee County Georgia, there is a large farm consisting of a white foreman's house and numerous negro tenements, as well as a number of animal sheds sheltering many mules, pigs, calves, etc. The farm lies between two large ponds, half a mile distant on either side, and during the summer season there are several other temporary breeding places of Anopheles quadrimaculatus in the immediate vicinity of the buildings. From the anopheline breeding standpoint the animal houses are mixed with the human habitations, so that anophelines from the breeding places can reach all kinds of mammalian blood in the neighborhood with equal facility.

The foreman of this farm maintains that the introduction of animals some years ago did not result in any decrease in the mosquito or malaria rates. This year I found that clinical malaria was very prevalent, and Dr. S. T. Darling found high parasitic and splenic indices among the employees. During my weekly inspections throughout the year I have found Anopheles quadrimaculatus to be numerous both inside and under human habitations and animal houses. It is clear, therefore, that in this area the animals do not act as an efficient barrier between mosquitoes and man.

At Miller's Pond, Florala, Ala., there is an area of impounded water in which Anopheles quadrimaculatus breed in large numbers. The miller's house is situated on a slight eminence about one-fourth of a mile to the north of this water. The last occupants of the house, who resided there until a year ago, sheltered their animals in sheds immediately adjacent to the house, and no other animals or houses were interposed between the residence and the pond. Mosquitoes were a pest inside and around the house and all the inmates suffered from malaria. Early in the spring of this year the new tenant erected a calf house surrounded by a stockaded enclosure, within thirty yards of the pond margin, and in a direct line between it and his residence. All animals (three calves and about six pigs) have since been kept within this enclosure and none has been sheltered near the tenant's house. I have made monthly inspections of this area since May. On all occasions a few Anopheles quadrimaculatus have been found under the mill. Under the new calf house as many as two hundred of the insects have been taken at one time. Females predominated, and most of the specimens contained blood. Even as late as the middle of October forty specimens were easily found. On no occasion during these visits was Anopheles quadrimaculatus found inside or under the tenant's house. The tenant has assured me that he and his family have not been worried during the season by mosquitoes in the vicinity of his house, although he admits that the insects are troublesome close to the mill in the evenings. None of the members of his family has suffered from ma-

*Round Table Discussion, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

laria or ill health during the year, although people living in houses on the other side of the pond have suffered as in previous years.

The mosquitoes found under the calf house were not examined for parasites, nor was the blood content of the insects determined, so this observation is necessarily incomplete, but comparing the present conditions with those so notorious in the past it would seem that the altering of the position of the animals in their relation to man and to the breeding place of the anophelines has resulted in the formation of a barrier.

Dr. Bull's reference yesterday to the individual attraction of some animals of the same species for mosquitoes suggests to me that young calves (aged from two to six months, such as those used at Miller's Pond) may be more attractive than older animals to Anopheles quadrimaculatus, and that the age of the animals may be a factor in considering the "barrier question."

The resting places of Anopheles quadrimaculatus: though Anopheles quadrimaculatus is most commonly referred to in relation to its prevalence inside and under human habitations and animal houses, yet it is to be found in much greater numbers in the large holes excavated at the bases of trees. This has been especially noted in Lee County, Georgia, in southern Alabama, and at Mound, La. When the trees are near the margins of the breeding places both male and female Anopheles quadrimaculatus are to be found, and then only a few of the females are found to have blood in the stomach. These are possibly newly emerged imagines. Where the trees are placed amongst human habitations, and some distance from the breeding places, then females containing blood predominate.

In the autumn, when the numbers of the mosquitoes tend to become smaller in the vicinity of habitations, they are still plentiful in the tree holes, and even in November, when on casual inspection of these holes they are not to be found, they can still be found high up (as far as four feet) in the interior of some trees.

In view of the small numbers of Anopheles quadrimaculatus found to be infected inside and in the neighborhood of houses, it would be interesting to determine the infectivity rate amongst these tree insects.

Further investigation is also required regarding the winter habits of Anopheles quadrimaculatus as to whether it hibernates or partially hibernates, coming out on the warmer evenings of the late autumn and early spring to feed. While carrying out practical measures against this mosquito, these tree shelters might be an important index and their presence should be considered.

Dr. L. W. Hackett, International Health Board, Leesburg, Ga.—It seems to me that there is considerable practical use to be made of these trees. We are after exact knowledge, of course, of the distribution of Anopheles in the bedrooms and the exact number that bite the people, and also of the exact places where Anopheles breed. It seems strange, considering the enormous number of mosquitoes found at Mound by Mr. King, that we were unable to find any such numbers of Anopheles at all. In June and July and the greater part of August it was a rare house in which we were able to accumulate more than seven mosquitoes after a rather prolonged search, and I think the maximum number we ever obtained from the house in Leesburg situated on the shores of the pond where they were breeding rather extensively was thirty-five. I was told that it occupied the entire time of one catcher for eight hours to catch all the mosquitoes in one house at Mound. Usually in fifteen minutes we were able to catch all the mosquitoes that we could determine by torchlight and by trained investigators, yet we had more malaria at Leesburg. It appears that from seven to fifteen mosquitoes can produce an enormous amount of malaria in a plantation area such as we were studying.

The practical use of the tree was shown by our failure to discover the larvae of Anopheles in the early and middle summer With the exception of one catch of fourteen quadrimaculatus pupae, we were able to breed only five up to the end of July. We could not find the larvae, although we took all the available water, and there was a good deal of it. We did find the adults in the hollow trees. Is it possible to use the trees as an index of the Anopheles breeding where it is impossible to determine it by other means? I believe we can, and we might even construct artificial trees, using this method as a short cut in determining the breeding of Anopheles, just as the spleen rate is a short cut in determining the amount of malaria.

I arrived at Leesburg in June and it became necessary to take a short cut to determine the amount of malaria. No one had done it the year before. By studying Dr. Darling's records I was able to select two plantations that, from the spleen rate, I thought probably would develop an intense malaria during the coming fall. The two plantations which I picked out in June did turn out in the fall to be the most intense foci of clinical malaria in the county.

Dr. L. D. Fricks, U. S. Public Health Service, Memphis, Tenn.—I wish to make just a brief comment on a statement which I understood Dr. O'Connor to make as to the possibility of attacking mosquitoes in tree holes during the winter months. Some time ago Dr. H. R. Carter, of the Service, prepared a table showing the enormous reproductivity of the female mosquito. Under favorable breeding conditions her progeny will amount to billions before the end of the season. Therefore, we do not consider it feasible to make any effort to destroy hibernating mosquitoes as a part of a malaria control program, nor do we depend upon killing mosquitoes in our summer campaign to reduce mosquito infestation. Pools are oiled to render them no longer mosquito-producing areas. We might do the same thing by drainage. They are not oiled to kill mosquitoes.

I understood Dr. O'Connor to say that there was a possibility that these hibernating mosquitoes might transmit malaria during the winter months because they come out on warm days and may bite. Several years ago Mr. Mayne, of the

Service, studied the hibernation of mosquitoes at Scott, Miss., which is farther north than Lee County, Georgia. Mr. Mayne found that in this locality the hibernating Anopheles frequently come out and bite on warm days, but this is quite a different matter from transmitting malaria during the winter months. The malaria plasmodium requires a much higher temperature for its development in the mosquito than is necessary to tempt the mosquito to take a blood meal. As a matter of fact, it appears that active malaria transmission does not take place in that part of the United States which we are discussing until summer is well advanced.

The question of using animal barriers as a protection against malaria mosquitoes and malaria infections in the United States, as raised by Dr. O'Connor, is a very interesting one and has been studied by several Service officers, particularly by Mr. C. W. Metz and Dr. M. A. Barber. Their conclusions up to the present, I belive, are that in the Southern states apparently animal barriers cannot be depended upon to protect the rural population against malaria infection.

Dr. Samuel T. Darling, International Health Board, New York, N. Y.—In malaria work each locality, each area, each community, must be studied by itself. What Dr. Fricks has just said about the observations in regard to the animal barriers probably holds true throughout the South. Work done by Dutch observers in Sumatra, however, seems to show that animals can be used to reduce the number of mosquitoes visiting habitations. I think the reduction was to something like one-seventh and was obtained by the construction of small huts near by in which animals were placed and by the use of two-storied buildings, the animals being placed underneath.

The interesting observations in regard to tree holes will be helpful in our efforts to find the various locations in which the adult mosquito rests. There is another great problem, one that deals with the preferential breeding places of Anopheles. It was found in the Orient that certain species of Anopheles only were found in certain types of breeding places and that others would not breed there.

Anopheles quadrimaculatus, the carrier of malaria, has certain tendencies; crucians and punctipennis have other tendencies. I think it may emerge that we shall be able to disregard at first the breeding places for which punctipennis and crucians have a preference.

Dr. O'Connor remarked that calves acted as an animal barrier at Miller's Pond. Dr. G. J. Carr, at our station, has made some observations which seem to show that children are more likely to be attacked than adults. Dr. Carr went to some of the plantation houses during the night to observe and he found that children were more attractive to the anophelines than adults. Dr. Hackett has noticed that clean houses in which only elderly people lived, and where there were no children, were less likely to be visited by mosquitoes than those in which children lived. Possibly the odor emanating from children makes them more likely to be visited by mosquitoes.

Dr. L. L. Williams, Jr., U. S. Public Health Service, Richmond, Va.—I was interested in Dr. O'Connor's suggestion that roosting trees might be constructed. Last summer in Virginia after a heavy rain Mr. LePrince suggested that we set out some boxes. We did so and the results have been very interesting. For instance, when we put out a nice, clean, white box we find the predilection of children with a handful of rocks for the box is much greater than that of the Anopheles. Some we were able to keep hidden, however. The second thing we found out is that an old, dark box is much better. Also we found that a long, narrow box always gave a greater catch than the others, particularly if it were standing on its edge instead of lying flat down. Toward the end of the season we found that quadrimaculati were roosting on the sides instead of the top and a few punctipennes were on the top. The boxes do fairly well, but not quite well enough. We find that old, abandoned sheds or little used bridges are better roosting places than the boxes we put out. If you have no such natural place the boxes will do, particularly, I suspect, if you paint them black inside. It is quite interesting to know that wherever we found full sized larvae through dripping we always found the corresponding adults, in sheds, sometimes in hollow trees, or in our boxes. On one occasion, where we could not find breeding on dipping, we did find some quadrimaculati roosting in some of the boxes, and a further search showed a small seepage area pretty well overgrown that was missed earlier in the season. It is a quicker method than dipping of getting information about the breeding.

Mr. W. H. W. Komp, U. S. Public Health Service, Crowley, La.—In Lake City, Fla., this method has been used with great success, with the modification that instead of constructing boxes we used things that were ready to hand, that is, old barrels. One end of the barrel was knocked out and it was placed on its side. If spider webs and other debris were in the barrel they were left there, as the mosquitoes seem to prefer such hiding places.

Comparison was made in Dr. Bull's experiment between the attractiveness of pigs and men for mosquitoes. In a series of experiments conducted by Dr. Barber mosquito traps were baited with pigs and with man and placed side by side, the pigs in one and the man in the other. The traps were entered at sundown and the man slept there all night. The mosquitoes that entered the trap were caught at dawn. We found that on some nights the pig-baited trap was more attractive, and on other nights the man-baited trap caught the greater number of mosquitoes. Altogether, there did not seem to be much difference in the two baits as regards attractiveness to anophelines. We also found that a number of the females caught in the traps had entered without subsequently biting, as they were not filled with blood. A similar observation was made in this connection by Mr. LePrince.

With regard to the number of larvae found in breeding places, as related to the number of adult mosquitoes found, in the rice field region around

Crowley, La., we bred Anopheles crucians more from larvae taken in the field than any other species. Yet we did not collect a single adult of this species from shelters where they had formerly been abundant earlier in the season, although Anopheles quadrimaculatus was found in large numbers in such shelters.

Dr. Darling mentioned the possibility of predicting the species of mosquito which might emerge from a certain type of breeding place. Some observations made on this subject in Georgia, Alabama and Louisiana seem to lead to the conclusion that there is little correlation of species and breeding places.

We have found that variations in the hydrogenion concentration in water affect the breeding of anophelines very slightly, as all three of our common species were found in waters of the highest as well as in the lowest concentration found in natural waters.

Mr. J. A. LePrince, Senior Sanitary Engineer, U. S. Public Health Service, Memphis, Tenn.—It may be possible that some individual animal of any species may be more particularly attractive to certain Anopheles, irrespective of the age of the animal. In "Mosquito Control in Panama" is mentioned an instance where one volunteer observer, who had an unusually pronounced attractivity for Anopheles albamanus, felt somewhat slighted when his party of five persons caught numerous Anopheles feeding on an old horse too weak to be offended or to move away. None of these five malario workers (even including the previously mentioned attractive individual) received a single bite, though all five were unable to keep up with the catching of Anopheles feeding on the horse, and many of the mosquitoes escaped after obtaining blood meals. This was on a dark night close to midnight and occurred near the cemetery near Cristobal, Panama Canal Zone. The gentleman referred to was the late Mr. Proctor, of Rodney, Mich., who served as sanitary inspector in the Canal Zone and died of pernicious malaria during one of his vacation periods at his home town in Michigan.

At Gatun, on the Isthmus of Panama, during the period of canal lock construction, there were marked flights of Anopheles albamanus and Anopheles tarsimaculata. In their evening path of flight was a stable where approximately sixty to one hundred horses and mules were fed and stabled every night. Apparently the Anopheles were but very slightly attracted to these particular animals, as none was ever caught in this stable, and the daily catches in and under the houses close by (say 150 to 200 feet) were not so large as those in houses a quarter of a mile or farther distant from the swamp the Anopheles came from. For some reason, not understood, these Anopheles persistently flew from their place of origin directly past the stable (ignoring it apparently) to houses a quarter of a mile distant from the stable, but did not go beyond the line of houses most distant from the stable and breeding area. A line of tents was placed beyond the last houses and artificial resting places constructed, but without positive results. Also, all bushes near the tents were thrashed, but no mosquitoes were seen.

Dr. O'Connor (closing).—I am sorry that I did not emphasize sufficiently that the density of mosquitoes at the tenant's house prior to the building of the calf house was well known. We knew that the human inmates in the house on the hill had been severely troubled by the mosquitoes, and the people who left there had left as much on account of the mosquito trouble as for any other reason.

MAJOR DRAINAGE PROBLEMS IN RELATION TO MALARIA*

Mr. J. A. LePrince, Senior Sanitary Engineer, U. S. Public Health Service, Memphis, Tenn.—At a former meeting of this Association one of the members stated that the control of malaria by means of drainage was probably a hopeless task in view of the extent of swampy lands that exist in many parts of the malaria belt.

It may appear to be a hopeless task unless we go into the subject so as to understand just how big the problem actually is, the relation of these areas to the existing malaria problem before us, and consider also how long these swampy lands may remain in their present condition.

Iowa, Illinois and Michigan were formerly in the malaria belt, but are no longer so considered. A large portion of the farm lands of Illinois are now tile drained. In Iowa there are about 35,000,000 acres, of which one-seventh are now in organized drainage districts.

It is only in recent years that large drainage projects have been undertaken in the South, and there is no apparent reason why this work will not extend rapidly. The former Director of the United States Reclamation Service states that natural growth of the population in the United States creates a demand for three hundred farms a day, even after taking into account the drift of people to the cities.

Regarding the swamp lands and overflow lands in the United States, you will find some very interesting data in the January, 1922, number of the National Reclamation Magazine. The United States Census figures quoted there indicate that about forty-four million acres of swamp and overflow land are already drained, or say a parcel of land one thousand miles long by seventy miles wide; and that an additional twenty-one million acres is already included in organized drainage projects. It is estimated that from fifty to seventy million acres remain to be drained.

What does this mean to us? Approximately it indicates that 32 per cent of our swamp lands have already been drained; 15 per cent additional is already in organized drainage districts; and

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53 per cent (estimated 70 million acres) yet remain to be drained.

It seems apparent, therefore, that in the near future half of our swamp lands will have been cared for. It is interesting to note that the greater portion of this work has been done within the past ten years. With improved excavating machinery now in use it will not take so many years to drain the swampy areas that some of us may have concluded would never be subdued.

A trip of a week's duration in some of the recent swamp reclamation projects will convince anybody that the water can be made to move on and the character of the farm crops shows that it pays to remove the water.

These drainage projects are initiated by petition of the requisite number of land owners to the proper official. The date of public hearing is fixed and a finding is made for or against drainage. The cost of improvements is assessed against lands benefited according to benefits received. In general, the state drainage laws are based upon the supposition that the proposed improvements will benefit public health, public welfare or public convenience. Many of our state drainage laws make some provision for maintenance of drainage systems, but these are too often not enforced.

Many people are under the impression that major drainage operations so reduce the production of Anopheles as to give a marked reduction in the prevalence of malaria, but so far as is known there has been no recording of this malaria reduction.

To what extent are these large present swampy areas a sanitary problem? Many of them have such a sparse population that they may form but a small portion of the malaria problem now before the state health officers. In many cases they may be more correctly considered as serious future potential problems. After incompleted drainage systems (minus Anopheles drainage) are installed in these swampy areas soon after the new population move into these freshly reclaimed lands is probably the time that the real problem may begin. It is never too early to start the campaign to get such folks ready to take care of themselves later on. A large amount of good work can be done through the farm and agricultural journals, the public press, and in country schools. Above all things such districts need efficient all-time county health officers who can convince the newly arriving farmers that it is essential to take precautions and also to install Anopheles drainage as early as possible. In the malaria belt we have too many financiers or leaders of development organizations who are completely ignorant of the relation of malaria to prosperous agriculture.

It is not so much a question as to whether our swamp lands will or will not be reclaimed in the relatively near future and turned into farms, as it is questionable whether or not the local health authorities of such future foci of malaria will be ready to anticipate and meet the emergency conditions that are already on the way to meet the health officers.

Also, this brings up the question as to what extent the smaller Anopheles production areas that remain undrained by the main outlet ditches and main laterals will continue to produce a sufficient quantity of Anopheles to spread malaria to be of serious sanitary importance. So far as the speaker is aware, little data is as yet available on this subject, but fortunately the matter is now being investigated. Another matter that will need most serious consideration is the maintenance of lateral ditches of major drainage systems. In many instances probably a large portion of them will be intermittently wet and dry during the Anopheles production season.

Engineers have not devised a mechanical apparatus for rapid and economical removal of the class of vegetation that flourishes in the lateral ditches of many of our major drainage projects. So far as the writer knows the millions of Gambusiae that are often present are the only ones who have given this maintenance problem the serious consideration it deserves.

Certain types of vegetation may keep Gambusia control of Anopheles in lateral ditches far below desired requirements, and much careful investigation will have to be done to determine the danger signals.

If the investigations recently started indicate that the lateral ditches or main drainage ditches can and do become serious sources of Anopheles production, then two protective measures may become necessary: the devising of better and more economical methods of maintenance, and arranging for the financing of such procedure. The latter will depend largely upon the viewpoint of the public. As a matter of fact, the day may soon arrive in some states when the state health department will have to take action in relation to laws pertaining to proper maintenance of drainage ditches of agricultural drainage systems.

In some instances drainage systems have not been given any maintenance attention until the carrying capacity of the large ditches has been so seriously reduced as to make redigging essential.

Within two or three years after lateral ditches have been installed, in rich soils they may contain grasses or plants from four to six feet high in addition to heavy growths of willows, cattails, joint rooting growths of mat-like form, and other growths that are at present difficult and expensive to remove. As investigations of the relatior of agricultural drainage systems to malaria hav been started only recently we cannot expect to obtain promptly all the data desired. So far as possible, it is desirable to determine to what extent these agricultural drainage schemes will reduce malaria without any supplementary work's being accomplished; also to determine to what extent these large drainage ditches produce Anopheles in quantity, why, and under what conditions. The next step will be to devise an economical remedy and a definite means of having the remedy applied before serious consequences follow. Unquestionably, the method of attack or control may vary with the character of the soil formation as also will the cost.

In the larger ditches in the stiff clay soils of western Tennessee we are able to install and maintain a "dry season flow" ditch in the bottom of the main ditches, and thus prevent a collection or series of stagnant pools. Such procedure in the alluvial black soils of the Mississippi Delta is not possible.

At the present time the constantly changing tenant population in agriculturally drained territory of the malaria belt complicates the problem of determining how much malaria is being contracted in areas of this character.

To a considerable extent we may have to be guided or measure our results by density of adult Anopheles present before and after agricultural drainage and by continuous careful examination of selected ditches over a period of several years.

Dr. C. A. Kane, Richmond, Va.—I wish to say a few words about what malaria control has done in securing county health units in Virginia. In one year's time, as a result of malaria control work, we have secured appropriations for seven county health units. Five of these units are now in operation and the other two will start in January. The main argument used in securing an appropriation from the board of supervisors was the work done in malaria control. In 1922 we had five urban demonstrations, as a result of which the above county health units were secured to do county-wide malaria control work. Nansemond was the first county in which a unit was secured as a result of the malaria control work done in Suffolk, the largest town in this county. We told the Health Officer there that the continuance of the health unit would depend upon the results secured and how much work he did in malaria control. Three weeks ago the Chamber of Commerce of Suffolk gave a dinner to the visiting health officers from foreign countries. Among the speakers was the Lieutenant-Governor of the State, and among the things stressed were the wonderful results accomplished in malaria control in Suffolk. One of the prominent judges of the district said that this was the first year in his life (he had lived there all his life) that he could sit on his porch and not be eaten up by mosquitoes. The State Board of Health had tried in these counties, several times, to put in county health units, but had failed to get appropriations. That was before they put in malaria control work. In only one county where urban control work was conducted did we fail to secure a unit and within six months of the time that we appeared before the board of supervisors, the board wrote to the State Health Department stating that they were ready to appropriate money for a county health unit; and this is one of the units which starts on January 1. The deciding factor in this case was the malaria control which was done in Smithfield, Va, the one place in Virginia where it had been considered that nothing could be done in public health.

Drainage was principally depended upon in all urban work, but was supplemented by some oiling. Drainage will be depended upon in nearly all future urban work which may be done by the county health officers. Doubtless some drainage work will be done in portions of the rural districts, but the local health officers will, of course, choose in their districts the methods that are most economical for their particular sections.

Dr. John A. Ferrell, International Health Board, New York, N. Y.—Interest should be manifested by the Southern states in the reclamation of fertile lands. This would stimulate an increase in population, enlarge the cultivatable area and automatically reduce the amount of malaria. In certain instances major drainage has been conducted in such a way that many breeding places were left which could have been eliminated with very little expense. The health authorities and the major drainage engineers should work in cooperation with a view to promoting the health as well as the economic interest of the community.

In southeastern Missouri the major drainage work has been extensive, but in many instances the opportunity completely to eradicate malaria was overlooked.

In regard to the discussion by Dr. Kane, of Virginia, I wish to say that the adoption of policy, programs, the selection of personnel, law enforcement and other administrative matters are functions of the public officials. The International Health Board carefully avoids exerting pressure on public officials in matters of administration.

The state board of health should decide as to the program it wishes to follow. If the plan proposed is one which commends itself to our Board and financial assistance toward carrying it out is requested it may be granted, but beyond making a contribution of funds our Board does not have and does not desire to have any administrative responsibility. It is anxious to see the public health organizations reach financial independence as soon as possible. It assists in financing demonstrations through the pioneering stage. It avoids contributions for maintenance and ultimate extension of the work. The success of a project it supports involves its elimination as a contributor within a reasonable period of time.

It contributed in the beginning to demonstrations of malaria control in towns. The work was successful. The time has arrived when the maintenance and extension of work of this type should be assumed entirely by the state and local authorities. It later gave support to movements to control malaria on a county-wide scale. This involved the establishment of county health organizations which would feature malaria control. This work is making satisfactory headway and at present it is felt that this is the type of malaria control most deserving of the Board's aid. Such county organizations will of course deal with other outstanding health problems as soon as malaria is sufficiently brought under control.

STATISTICAL INVESTIGATIONS*

Dr. W. A. Plecker, State Registrar of Vital Statistics, Richmond, Va.—The question of statistics in malaria is rather a disappointing one. There are several reasons for this, one being that the death rate in malaria is low in comparison with the importance of the disease. The securing of morbidity statistics is an extremely difficult thing. In the State of Virginia this is not under the supervision of our office, the Bureau of Vital Statistics, but is under the Bureau of Malaria Control. There does not seem to be very much success in getting reports of the morbidity, and the securing of accurate death statistics in regard to malaria is also difficult. Those of you who are working with statistics know that there is a great tendency among the older physicians to ascribe deaths to malaria when they do not know the exact cause.

In parts of the State where large industrial insurance companies work there is an impression among colored people and colored physicians that if a person dies of pulmonary tuberculosis or other pulmonary disease within a year after securing insurance he will not get the full amount of his insurance. I have been assured by the Metropolitan that this is not the case, and that they will get the full amount, but that may not be so with some of the smaller companies.

In one of the tidewater cities, we had a report of eight deaths last year from malaria, and all of those deaths occurred in the practice of three colored physicians, one reporting four, another three, and another one. This year already four deaths have been reported in the practice of the physician who reported four last year. We investigated this and found that there is a tendency to report deaths as due to malaria when really they are due to some other cause. We have some deaths reported from diphtheria in children only a few weeks old, or only a few days old. I believe those children die of congenital debility or some other cause and the old grannies hear the rattle in the throat and call it croup, and the Census Bureau classifies it as diphtheria.

Another cause of death that doctors do not like to report is puerperal septicemia. Doctors do not like to admit that they have lost a patient from that cause, so they occasionally charge it to malaria.

We have had quite a few deaths from malaria reported from two counties. Last year we had reported forty-nine deaths from malaria in Virginia. Of these, eight occurred, I believe, in one county, and eight others in the adjoining county, making sixteen. It seems that the physician reporting from one city went over into the other county and reported. I called his attention to the fact that we do not look upon malaria as such a fatal disease, and that it would take four hundred doctors, on an average, to report as many deaths as he did.

We have in our Bureau some old records of births and deaths, and also marriages, going back to the year 1853. It became interesting to me, a short while ago, to find out what those people died with, and I selected Richmond City to investigate. Of course the deaths then were very incorrectly reported. We estimated that perhaps only 60 per cent were reported and the rates would not be at all accurate. We adopted the plan of counting out one thousand deaths, checking them alphabetically (which is the way they are arranged) and comparing them with one thousand that occurred last year. It was amazing, as we ran down that list, to see the number of deaths from typhoid fever, from childbirth, from scarlet fever and diphtheria. These records will make valuable history, I believe, if we can get them out and in shape.

My investigation showed that we had 1.8 deaths from malaria to a thousand deaths. This, you know, is not the way we usually figure rates. In 1853 we had four, over twice the number. In addition to that, we had a large number of deaths in those old records from "bilious fever." Probably some of those were typhoid. I think also a considerable number of them were due to malaria. There was also "congestive fever." That may have been pneumonia, or it may have been meningitis, but possibly some of those were due to malaria. I think we can learn from those old records that the death rate seventy years ago from malaria, to say nothing of the morbidity, was much greater than it is today. If we compare our more recent figures I believe they will show quite a decline in deaths from malaria in recent years, especially since the activities of the malaria fighters began.

Another thing is that the physicians are being educated to diagnose malaria. When we can get them to use the laboratory to make accurate diagnoses we shall have more accurate vital statistics.

Dr. K. F. Maxcy, U. S. Public Health Service, Montgomery, Ala.—What Dr. Plecker says about the inaccuracy of death certificates is all too true. Yet they furnish the only means of measurement at present available to indicate the prevalence of malaria on a common basis in all the states involved. Can we use them?

It is well known that forty years ago the diagnosis "malaria" was used to cover a wide field of human ailments, "neuralgias," "colics," "dysenteries," "dropsies," "leukemias," "cachexias," etc. With the great advance in medical knowledge which began in the eighties and nineties, the art of diagnosis has become increasingly exact. Appendicitis has taken the place of "bilious colic." The bacterial and dietary causes of dysentery and diarrhea have come to be better appreciated. The etiology of a large number of conditions, hitherto not well understood, have been clarified. Much that had been attributed to "malaria" was undoubtedly due to hookworm. With the more extended use of the microscope, the diagnosis "malaria" is being reserved more and

*Round Table Discussion, National Malaria Committee (Conference on Malaria), meeting conjointly with Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

more for the specific disease caused by the blood parasite described by Laveran. Yet there is still a considerable error in death certificates. Can we estimate its size?

Obviously autopsies are out of the question. In Alabama, for a given period each death certificate on which "malaria" was given as a cause of death was followed up by a special inquiry, asking the physician who had signed the certificate whether he felt certain of the clinical diagnosis and whether he had confirmed it with a blood smear, encouraging a little honest confession.

Replies were received in 220 instances, representing about 80 per cent of the certificates. They indicated that: in only 6 per cent of the deaths had the diagnosis been confirmed by blood smear; in 48 per cent the physician felt reasonably certain on clinical grounds alone; in 24 per cent the physician was doubtful; in 14 per cent an error had been made, and in 8 per cent no physician had been in attendance. From these results we judge that not more than 50 per cent of the deaths attributed to malaria on death certificates in Alabama should really be charged to that disease.

Recognizing that there is a large primary error, does the error compensate itself so as to make the information useful over a long period of years? I think the proper attitude is this: that malaria death certificates should be looked upon as deaths attributed to malaria. Deaths attributed to malaria indicate that malaria may be prevalent in the community. In other words, malaria becomes a satisfactory diagnosis to the physician and to the patient where the disease is prevalent.

The location of deaths attributed to malaria in the United States does correspond, in a general way, with what we know of the distribution of this disease. In an individual state, a spot map showing the location of "malaria deaths" may be very helpful. On the other hand, when death certificates are used to indicate the trend of the disease, the result must be interpreted with a great deal of caution. But I think we should not be entirely pessimistic.

The same may be said of morbidity statistics. They leave much to be desired. Physicians see, perhaps, only from 10 to 20 per cent of the cases occurring. We should look upon these reports as notification rather than morbidity. The physician notifies the health officer that he thinks he has a case of malaria. It is up to the health officer to establish the value of the report by a field investigation.

An attempt has been made to measure quantitatively the relation, or correlation, of death certificates and morbidity reports. In Mississippi some very excellent statistics have been collected. There are criticisms, perhaps, of the method of reporting cases of malaria in so far as each case is not reported by name. At any rate, Dr. Leathers has been able to get a response from about 90 per cent of his practicing physicians once each month as to the number of cases of malaria they have seen during the month. There are eighty-two counties in Mississippi. For each county there was derived an average malaria morbidity rate and an average mortality rate based upon a four-year period, 1919-1922. The coefficient of correlation worked out to be .81, considerably higher than we expected. Of course, in individual instances, there were considerable discrepancies, but in a general way there was a rather marked agreement between the morbidity rates and the mortality rates as to the relative importance of the problem in different counties.

Notification may occasionally give very important information. A case of malarial hematuria was reported in a city in Alabama where there was known to be no chance for active transmission of the disease. Upon inquiry, it was found that the patient had been visiting relatives in a near-by town. When these relatives were investigated, they were found to be living on the edge of a town near an area which was producing Anopheles quadrimaculatus heavily and several of the family had already been reported as having had malaria. This was strong circumstantial evidence that malaria transmission was taking place on the edge of this town and the necessity for control measures was obvious.

In the past two or three years a great deal of stress has been laid upon the necessity of a satisfactory measuring rod for malaria prevalence in our meetings. This is obviously desirable where the effect of control is being studied for scientific purposes. It is expensive, however. On the other hand, from the point of view of the practical public health administrator, is it necessary to go to the expense of carefully measuring the amount of malaria in a locality before and after control measures have been instituted? Is it not sufficient to show that in a given area malaria transmission is taking place? If transmission is taking place, then control measures should be instituted. If these are successful, it should become apparent that transmission is no longer taking place.

Mr. E. W. Kopf, Metropolitan Life Insurance Company, New York, N. Y.—In the Industrial Department of our Company we report a decline of 58 per cent in the malaria death rate of white persons and of 64 per cent for colored persons since 1914. It is difficult, of course, to say what this signifies, because of the known tendency to ascribe deaths from other causes to malaria. Assuming that this tendency of incorrect certification is no stronger in one year than in another, these figures may be taken to suggest a real decline in malaria prevalence among our policy holders in Southern cities and small towns.

Industrial insurance companies pay claims from tuberculosis and there should be no hesitation on the part of physicians to report these deaths, nor should they certify them as due to "malaria." The percentage of declined or contested claims on so-called industrial business is infinitesimal.

The life insurance companies have carefully observed your efforts to control malaria in the South. As soon as conditions became favorable in certain localities, underwriting facilities of the older companies were extended, and new compa-

nies were organized by local groups in the South, so that at the close of 1922 $9,160,000,000 of life insurance protection was in force in the South and Southwest. In that year more than $76,000,000 was disbursed in death claims by companies and societies operating under your insurance laws. In the years 1900 to 1915, on business in the Southern states, the mortality ran from 3 per cent in excess of the expected standard rates in the northern tier to 24 per cent in excess in the four states, Alabama, Arkansas, Louisiana and Mississippi, combined. The facts are shown below:

Mortality During Years 1900 to 1915, American Life Insurance Companies, Showing Death Losses (a) Expected According to the American Men Standard Lives Table and (b) the Actual Losses in Specified Areas

Area	Expected Loss	Actual Loss	Percentage Actual of Expected Loss
Delaware, District of Columbia, Kentucky, Maryland, N. Carolina, Tennessee, Virginia, W. Virginia	$41,815,100	$43,133,300	103.2
Florida, Georgia, S. Carolina	11,073,600	13,703,600	123.8
Alabama, Arkansas, Louisiana, Mississippi	10,626,400	13,181,500	124.0
Oklahoma, Texas	6,557,400	7,143,200	108.9

Of course, conditions have been markedly improved since these figures were compiled. It will be of interest and value to health officers of Southern states to have later data, covering, say, the period 1916-1925. They can then show their fellow citizens two things: (1) that public health work pays the average citizen in cutting the claim cost of his life insurance, and (2) a favorable mortality rate encourages the companies to open up areas which were subject to proscription under former conditions and where the benefits of life insurance as protection to families and as a bulwark for productive credit is today denied them.

An agricultural community such as you have in the South needs low-cost life insurance as a foundation stone for personal credit. Ask your banker. It would never do to expect policy holders in other parts of the country and in Canada to make up a 25 or 30 per cent deficit in claim funds of the life insurance companies. More and cheaper life insurance follows the sort of public health work you have been doing in the South.

When life insurance reaches a sizable volume in any Southern state, the funds go back to you as investments in schools, roads, bridges, drainage projects and railways. Just what that means in terms of a rise in the level of well-being no one has determined. But life insurance growth, following public health developments, means an increase in capital values for every state that shows determination to reduce the premature deaths of its citizens.

Your Committee on Statistics should each year endeavor to collect facts on malaria and on its economic, social, climatological and other aspects and tell the world what the South has done and is doing. Gathering statistical facts in itself is all right, but no statistics committee is doing half its job until it seeks to tell what the statistics mean.

May I direct your attention to a movement begun in New England to study the resources of specific regions and to organize for effective work the local agricultural, financial, public health and welfare facilities? Under the auspices of the Massachusetts Department of Agriculture, at the suggestion of Governor Cox, a New England Agricultural Conference was called in Boston during January, 1923. Not only were dirt farmers present in numbers, but many of the leaders in the industries and financial groups of six New England states lent encouragement by their presence and were active in the work of the convention. Committees were appointed and among the things accomplished this past year were the assembling of information on food production and food consumption in New England, the marketing of farm products, cooperative effort in agriculture, agricultural laws relating to interstate trade, etc. Another conference is to be held in Concord, N. H., on January 16 and 17, 1924, at which the whole question of revitalizing and reorganizing New England agriculture will be discussed.

It seems to me that your Association, through its Public Health Section, could suggest regional conferences in the South, emphasizing the dependence of essentially rural states upon the well-being of the agricultural population. This would give you an opportunity for stressing the economic importance of malaria eradication and the needlessly depressed capital value of areas now under serious public health disabilities. Rural welfare in the South is definitely tied to rural sanitation and to agricultural organization. No doubt Dr. Welch and Dr. Leathers could initiate local regional survey efforts in association with the state universities, business and farmers' organizations, which would show the citizens what opportunities for economic progress there are in the South. Southern health officers need only sufficient funds to make their state public health work what they think it should be. And funds will be appropriated only when legislators can levy an equitable, popular tax upon a generous community income.

I have in mind a certain region in the northerly tier of your states. Thirty years ago that region had indifferent commercial railway service. Fifteen years ago fast freight service for perishable products was inaugurated. Immedi-

ately after that the farmers of that region began to ship milk, cream and chickens to the Norfolk, Philadelphia and New York markets. The local business interests saw what the change meant. Today those counties have better schools, roads, bridges, a stimulated group of manufacturing industries and a contented population. The credit of cities in those counties is such that they rarely pay more than 5 per cent for their money. Have you ever thought what relation there is between a 6 or 7 per cent interest charge for financial accommodation in some of your Southern counties and the fact that you cannot, somehow, get money to do what you want to in certain regions? Why not ask your Section Committee on Statistics to get these facts and to organize regional resource surveys?

Remember that certain areas in the North had as much malaria forty years ago as you have today in what are considered the worst areas in the South. Malaria was not eradicated, and could not be eradicated, in Michigan, New Jersey and the Wallkill Valley of New York State, to quote a few instances, until money was raised for drainage and for industrial development. Granted that the South will organize the facts for specific regions, and act upon these facts, there is no reasonable doubt that malaria can be eradicated. The first approach is to increase taxable wealth and income.

Dr. George E. Vincent, President, Rockefeller Foundation, New York, N. Y.—I have been most favorably impressed by the careful analysis and modest interpretation put upon malaria statistics this afternoon. This seems to me an admirable piece of cautious scientific work.

I assume that one of the functions of this Committee is to make sure that these researches are being carried on in a co-operative way. I would not for a moment advocate the factory-like organization of research. Conscious comradeship is a quite different but all-important thing.

One sometimes feels that when we are ready to give up in despair we turn almost pathetically to education as the solution of our problem. We are compelled, however, to recognize limits of education. I suppose public health education with respect to this malaria problem consists not in having a whole population technically instructed, but in getting a sufficient number of people to have confidence in the knowledge and efficiency of those who are doing the work.

Malaria work has an advantage in that it is carried on for the most part in areas where the people are not distracted in all sorts of ways. It secures the cooperation of the public. It seems to me that in education we may rely too much on visual appeal, especially upon the motion picture. There is a real need for a thorough study of the actual effects of public health education.

SURGERY

RAILWAY, INDUSTRIAL, GYNECOLOGICAL, OBSTETRICAL AND UROLOGICAL

PERI-ARTERIAL SYMPATHECTOMY*

By JAMES F. MITCHELL, M.D.,
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During the last few years there has been developing a steadily increasing interest in the sympathetic nervous system as a point of surgical attack. This is in great part due to the stimulus given by the work and writings of Rene Leriche of Lyons. That the best estimate of the value of any new or unusual procedure may be obtained, it is necessary to record experiences with it, to collect and analyze results, both good and bad. It is for this reason that, in spite of the rather profuse recent literature, I am presuming to add to the rapidly increasing number nine peri-arterial sympathectomies. All surgeons are familiar with the older attacks upon the sympathetic nerve for the relief of various conditions. Among the earliest of these was the removal of the cervical ganglia for glaucoma, first advised by Jaboulay and Jonnesco. In 1905, I operated upon a woman with glaucoma, removing both superior cervical sympathetic ganglia, with complete relief of the condition. Many favorable results have been reported, but the operation does not seem to have remained popular. It has been recommended also for the relief of exophthalmic goiter, epilepsy, trifacial neuralgia and cerebral anemia, but the results have never created any enthusiasm. Nevertheless, it is generally conceded that the chief effect of ligation of the thyroid arteries in hyperthyroidism is due to the interruption of the accompanying sympathetic nerve.

More recently the excision of the cervico-thoracic sympathetic ganglia has been applied to the treatment of angina pectoris. Gomoin, in 1921, stated that this operation was first done by himself and Jonnesco in 1916 and that the patient after five years still remained well. Cutler, in Cushing's Clinic, has recently had favorable results in several cases, and it would therefore seem that this procedure offers some hope in an otherwise hopeless condition.

The work of Kappis, Braun and others on the blocking of the splanchnic nerves to obtain intra-abdominal anesthesia has opened a large field and has led to direct attack upon these nerves for the relief of abdominal pain. Gomoin, in 1914, successfully resected the semilunar ganglia for tabetic crises, an operation which he designated as "solarectomy." Jianu reports two cases in which he extirpated the splanchnic nerves and the semilunar ganglia for the same condition. Sacral sympathectomy has also been done by Jonnesco for pelvic pain, especially that due to inoperable cancer of the uterus.

To Jaboulay is attributed the first direct operation upon the sympathetic nerves of the extremities. In 1889, he conceived the operation of peri-arterial sympathectomy and applied it successfully for the relief of perforating ulcer of the foot. His work has been carried on by his pupil Leriche, who has published a long series of articles since 1913. Leriche's report before the American Surgical Association at Toronto, in 1921, was enthusiastically received and has stimulated much experimental and clinical work in this country. In the last year there has been a flood of articles in American and foreign journals. A review by Christopher in September covers one hundred and four and many have appeared since. While there is some disagreement as to the physiology and anatomy of the sympathetic nerves and there is still need for experimental research and observation, nevertheless reports on the whole are favorable and establish the operation as having a definite field of usefulness in a series of otherwise intractable conditions. The physiology on which it is based is not altogether clear. However, it is generally understood that

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arteries are controlled by vasomotor nerves which, whatever their origin, reach the artery by way of the sympathetic ganglia. The ganglia and their associated fibers lie in the adventitia and the fibers terminate in the muscular coat. Under direct stimulation these nerves cause contraction of the artery and its terminal arterioles and capillaries, thus lessening the blood flow in the area of supply. When the vasomotors are out of commission there is a corresponding dilatation and increased blood supply. Under normal conditions a proper balance is maintained. Leriche assumes that pathological stimulation of the vasomotor nerves or disturbance of the normal balance is responsible for a variety of peripheral conditions characterized by circulatory and trophic changes, and aims to restore normal conditions by excising the peri-arterial sympathetic or vasomotor nerves, proximal to the lesion.

The technic of the operation is simple. The femoral artery in the leg or the brachial in the arm is exposed for a distance of 8 to 10 centimeters and lifted from the common sheath on tapes or rubber tissue. A longitudinal incision is made in the adventitia and the whole outer coat with the surrounding fibrous tissue is removed with knife, scissors or blunt dissector. Leriche lays great stress on the importance of thorough and complete removal. At times there seems to be only a loose fibrous network, but by persistent dissection finally these films are found to amount to a real layer. I have found that the best method is to make an incision and then insert and spread beneath the incised layer a fine curved mosquito clamp. In this way one layer after another can be picked up with fine toothed forceps, incised and stripped anteriorly and the whole coat freed posteriorly as a well defined band of tissue lying between the artery and the supporting tapes. By keeping the artery moistened with salt solution, the strands of loose tissue are readily seen and the dissection must be continued until the artery presents everywhere a glistening surface, i. e., its middle coat. In regard to the ligation of branches encountered in the course of the decortication some may be spared, others ligated at a distance and divided. It is sometimes simpler to continue the stripping on to the branches and then ligate with fine silk within the outer coat. In this way one avoids the danger of pulling off ligatures placed before the stripping is begun. The artery is not weakened in any way. Leriche has verified this by examinations after four and eight months. There is little danger of wounding the deeper coats. In two cases of sixty-four Leriche made a small tear in the artery without serious results. Sherwood reports one case in which an unusually sclerotic and brittle artery was injured, making necessary an amputation which had been previously contemplated. Local anesthesia is most satisfactory and in my experience a general anesthetic has been employed once only and then because the patient positively insisted. Naturally adrenalin is not added to the novocain because of its marked vasoconstrictor action.

During the decortication of the artery its lumen becomes greatly reduced in size and its pulsations lessened. This is more marked with the brachial artery as has been observed also by Callander. In one of my cases the brachial artery contracted into so small a cord that the stripping was extremely difficult. All pulsation disappeared and the hand became alarmingly cyanosed and cold and remained so for nearly twenty-four hours, gradually clearing up.

Leriche describes as a constant postoperative phenomenon an increase in surface temperature distal to the decortication. This appears from a few hours to thirty-six hours after operation and persists for two weeks. With this he finds a corresponding increase in blood pressure. These observations have not been corroborated by all observers. In some of our cases there was marked increase in surface temperature; in some no change could be detected. In all there was evident improvement in the circulation in the days immediately following operation. Most striking of all was the relief from pain which came occasionally within a few hours and usually within two days.

The conditions for which Leriche proposes this operation as a remedial measure are those which he claims are due to some sort of trauma to the sympathetic

nerves, either efferent or afferent. There are thus included a host of circulatory and trophic disorders: Raynaud's disease, acrocyanosis, obliterative endarteritis, vasomotor trophic neuroses with contractures, painful or ulcerated amputation stumps, causalgia, etc. It is contraindicated in sclerotic or diabetic gangrene, although in the former there may be obtained relief from pain until amputation becomes necessary. Naturally suggestions are beginning to appear for its application in other conditions as for tuberculous joints (Florescu) or glands and organs which begin to show signs of insufficiency. The results on the whole are good, although absolute failures may be expected. Perhaps the most consistently good results are obtained with Raynaud's disease and trophic ulcers. While it is true that it is difficult on anatomical and physiological grounds to explain the clinical phenomena which Leriche has reported, nevertheless as Muller says, "Theory must sometimes give way to facts."

I have done this operation nine times on seven patients, the brachial artery twice and the femoral artery seven times being the point of attack. All were of the general type of Raynaud's disease. The first was done in January, 1922, and has thus been under observation for nearly two years. Both femoral arteries were decorticated. Within 48 hours pain had practically ceased and the sluggish ulcers representing the stumps of the toes soon assumed a healthy appearance and have healed. From being practically bedridden the man is able to get about with comfort. He is considering having the operation upon both brachials. The second case had a sympathectomy upon the left brachial artery in June, 1922. During the operation the hand became cold and cyanosed and remained so for 24 hours. He left the hospital in a week. A note in October stated that the hand was greatly improved. He has recently had one of his femoral arteries decorticated by Dr. Borden, showing that he feels benefited by the previous operation. The four next cases were done about the first of June, 1923. Two of these showed the characteristic postoperative reaction of increased heat in the hand and foot, respectively, on the morning after operation with absolute and permanent cessation of pain. Another in which both femorals were stripped has been the least satisfactory of the group. He states that he still has pain, but does not need sedatives at night as he did before the operation. The fourth of these has been most satisfactory. This patient had been for many weeks suffering such intense pain with a gangrenous patch on his great toe that he had been forced to give up his office work and was having morphin hypodermically every night. He was almost immediately relieved. The toe cleaned up and healed quickly and he is now entirely free from pain and in excellent health.

The last operation, done less than a month ago, is too recent to judge as to permanent results. She, too, came in with a gangrenous toe and very dependent upon opiates. The immediate result was most striking. At the end of 48 hours healthy granulations had appeared and in two weeks the toe healed. She was free from pain and sleeping well with no opiates.

This group of cases must certainly be classed as satisfactory in that all have received some relief and some of them so far as our observation goes seem entirely relieved. It is true that the longest period of observation is not yet two years and we cannot say what the future may bring. They are enough, however, to justify our recommending peri-arterial sympathectomy as offering some possibility of relief in many trophic and vasomotor disturbances of the extremities, painful and intractable conditions for which in the past we have been able to do little.

Case I.—H. G. was sent by Dr. Parker. He was 42 years of age and a violinist. He had a history of vasomotor disturbance of the extremities dating to childhood, with pain and ulceration and gangrene of the toes from 1911 and for four or five years the same with the fingers. Intense pain in his feet and legs at night made him lie awake for hours.

The arms and legs were cold and cyanosed. All the toes were gone from the right foot, and the base of each was represented by a dirty ulcer. On the left foot half of the great toe and first toe were missing. Portions of fingers of both hands were missing.

The operation, January 26, 1922, was sympathectomy of the left femoral artery; and on February 6, 1922, sympathectomy of the right femoral artery.

Result.—There was almost immediate relief from pain. In a few days the color of the feet

improved and the ulcers showed healthy granulations. They have all gradually healed. In October, 1922, he was in excellent condition, free from pain and thinking of having the same operation done on his arms.

Case II.—S. S., sent by Dr. Borden, was 47 years of age. His trouble dated back two years, when he had the left index finger amputated for gangrene. At that time the left hand and foot were involved. Six weeks previously the right foot became involved. Pain was intense in the hands and feet, especially at night.

The diagnosis was Raynaud's disease, and operation, January 31, 1922, sympathectomy of the left brachial artery. Result: The artery was contracted into a small pulseless cord during the operation and the hand became alarmingly cold and cyanosed. This persisted for 24 hours, during which time he had some pain. He left the hospital in nine days greatly relieved. In October, 1923, he was free from pain in the left hand and arm. Dr. Borden has just done a sympathectomy on the right femoral.

Case III.—J. C. B. was sent by Dr. English. He had a long history of Raynaud's disease. He had been under the care of Dr. Barker, by whom the diagnosis was made. He complained of agonizing pains in legs and feet, especially at night, so that he never had a good night's sleep.

Operation, June 22, 1923, sympathectomy of the right femoral artery, and June 26, 1923, sympathectomy of the left femoral artery.

Result.—Three days after the last operation he was in great spirits and stated that he had no pain whatever. He was sleeping well without any sedative.

He was seen in October and stated that he was having some pain. He looked better than before the operation and had gained in weight.

Case IV.—F. B. R. was seen at Veterans' Hospital with Dr. Parker. He was 32 years old. He served overseas 11 months and in February, 1919, in France had both feet frozen. That fall he began to have vasomotor disturbances in the feet and in October, 1920, his right leg was amputated for gangrene. In November, 1922, his right hand began to be painful. In December, the tips of his second and third fingers became black and on admission to the Hospital they showed dry gangrene.

The diagnosis was Raynaud's disease. Operation, June 1, 1923, was sympathectomy of the right brachial artery.

Result.—On the morning after the operation the hand was warm and slightly flushed. On the second morning he was free from pain and said that he had had the first night's sleep without pain for six months. Within a few days healing began in the fingers and by July 1 both were healed. He was discharged well on August 18.

Case V.—J. E. B., age 32, was seen at Veterans' Hospital with Dr. Parker. While in training in 1918 he began to have pain in the right leg, and later in France in both legs. In 1922, he was in bed for six months because of severe pain in the right leg. In October, 1922, he began to have pain in the left leg. In November, 1922, ulcers formed on the little toe and great toe which in May, 1923, showed no tendency to heal. Pain at night was so severe that he could not sleep and it was almost constant during the day. The diagnosis was Raynaud's disease.

Operation, May 23, 1923, was sympathectomy of the left artery.

Result.—On the day following the operation he stated that he was entirely free from the severe pain and that the foot felt "natural" for the first time in many months. The foot was warm and the bluish color about the great toe was less marked. The toe began to heal. On October 1 the toe was quite healed and the patient had had no pain since the operation.

Case VI.—H. B. R., age 50, was seen with Dr. Foley. For some years he had been suffering with Raynaud's disease and lost at one time the greater part of the little toe of the left foot. There has been pain and a brawny edema of the right foot, but no gangrene. He had had for many weeks an ulcerated area on the great toe of the left foot which did not tend to heal. He suffered with terrific pain in the left foot and for some time has been having a hypodermic of half a grain of morphia at night in order to sleep. He has had to give up working in his office.

Operation, May 22, 1923, was sympathectomy of the left femoral artery.

Result.—On the day following the operation he stated that he had had the most comfortable night for months. The foot was warm and the color improved. On June 11 the toe was nearly healed and was completely healed in July when he returned to his office.

He was seen November 1 and was well and free from pain.

Case VII.—Mrs. C., age 60, was seen with Dr. Parker. About six months before she began to have vasomotor disturbances with pain in both arms and legs. A few weeks previously an area of gangrene appeared on the third toe of the left foot involving the whole distal phalanx. She had become very dependent upon opiates.

Operation, October 23, 1923, was sympathectomy of the left femoral artery.

Result.—On the day following operation the pain had almost entirely disappeared. In 48 hours the slough came away from the toe and the granulations assumed a healthy appearance. Sedatives were no longer required. She left the hospital in two weeks with the toe healed and free from pain.

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DISCUSSION

Dr. E. Starr Judd, Rochester, Minn.—I had some experience with sympathectomy of the supe-

rior cervical ganglion in two types of case, one the exophthalmic goiter, especially where the exophthalmos persisted after thyroidectomy. We did quite a series with removal of the sympathetics with striking and almost immediate results, a marked change being noticeable by afternoon if the operation was done in the morning. However, in all those cases it was temporary and in a few days the patients were back where we started. We had something of the same experience with the epileptics. When Jonnesco was in this country speaking on this work, which is not yet published, we became interested and tried to accomplish something for epileptics by operations on the sympathetic ganglion. We had an opportunity to try it on a number of cases of epilepsy in the insane hospital and obtained what we thought was a remarkable improvement. One or two patients were released from the hospital for epileptics, but the trouble returned. The result was much the same as that obtained in epilepsy with any sort of surgical procedure.

Regarding sympathectomy in peripheral vessels, Dr. Sistrunk has done about 15 operations in all. Unfortunately our cases have not been the best suited for this type of operation. We employed a modified Handley-Leriche operation. Dr. Sistrunk has been of the opinion that the results are about the same with either the Leriche or the Handley modification. The results in Buerger's disease are not so good as might be expected, but some are very striking.

Dr. Mitchell said that the striking thing was the relief of pain. The patients were all better so far as pain was concerned. In endeavoring to find out whether the blood volume was changed in any way, Dr. Brown at the Clinic made several estimations. In normal persons, according to his method of examination, the flow is about 18 to 20 mils a minute. In a case of Buerger's disease the volume was 12 and 13 mils and three days after operation it had increased to 13 mils in the right foot and 16 in the left. In a third case it was 17 mils in one foot and 15 in the other and five days after operation it had changed very little. In another case it had increased from 13 mils to 18 mils five days after operation. Apparently while the blood volume is changed temporarily, the relief is not so great as would be expected.

Dr. Barney Brooks, St. Louis, Mo.—As Dr. Judd says, regarding the operation of perivascular sympathectomy, it is very difficult to find the cases for which it is suitable. Examination of many amputated specimens for the manifestations of diseases of the arteries of the extremities has convinced me that the vast majority of the symptoms are due to actual anatomical obstruction of the arteries. It would seem, therefore, as if true Raynaud's disease is an extremely rare condition.

There are two important factors in reference to blood flow through an extremity: the volume flow and the intravascular pressure. These two factors are obviously related, but I am convinced that it is possible to have a volume flow sufficient to maintain life and an intravascular pressure too low properly to distribute the circulating blood. In such a condition the patient may be benefited by producing a venous obstruction sufficient to balance the circulation.

The greatest need at the present time in the diagnosis and treatment of blood vascular diseases of the extremities is accurate methods of examination. At the present time there is no known method by which the exact site and extent of obstruction of the arteries can be determined. We have recently been using a method in which the arteries are filled with a solution of sodium iodid and x-ray photographs are made. This method gives valuable information as regards the character of arterial disease.

I wish particularly to call attention to the fact that the relief of pain which is often attributed to the operation of perivascular sympathectomy is also seen after other measures which do not interfere with the arterial sheath. For example, we have seen as striking a relief from pain after an intra-arterial injection of sodium iodid as we have seen after peri-arterial sympathectomy.

Dr. Mitchell (closing).—The discussion has brought out the points we had already made, that it is extremely difficult on physiological and pathological grounds to explain just why these operations do good.

I do not believe the simple application of a tourniquet would bring about quite the same result which is achieved by operation. Temporary relief from pain we might get. Just what is accomplished by this procedure, whether normal balance is restored as Leriche claims, or whether there is an increased supply, I do not know. We have noticed in several cases that the foot has been warm whereas it was cold before operation, this warmth coming on twelve or fifteen hours after operation. Also, ulcers that showed no healing whatever before showed healthy granulations ten or fifteen days following operation and healed rapidly. When we see these and the relief of pain which in one man has lasted about two years, it certainly seems that theories must give way to facts, and if we can help patients by this simple operation done under local anesthesia, it is well worthy of the trial. Just what cases are suitable for it time will have to tell.

FRACTURE OF THE NECK OF THE FEMUR*

By E. DENEGRE MARTIN, M.D.,
New Orleans, La.

Those who have read the literature and have had any experience with fractures of the long bones, know that fracture of the neck of the femur is the most difficult of all to deal with, especially in the aged, for the reason that osteogenesis is slow on

*Read before Southern States Association of Railway Surgeons, Auxiliary of the Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

account of the porosity of the bone as well as the diminished blood supply. It is not only necessary that the parts be placed in apposition, but they must be held there for a long time in order to secure bony union. With these facts in mind, I wish to report the improved technic of a method which was apparently tried but forgotten. There is today, so far as I know, no technic which by itself will secure results without the use of a plaster cast to immobilize the thigh. By the Whitman treatment we force the fragments together and keep them firmly fixed between the trochanter and the pelvis, and this position the patient must endure for weeks with the uncertainty of union or a functional result. I have seen so many unsatisfactory results in individuals ranging from fifty to eighty years of age that I thought that instead of fixing the thigh or trochanter to the head, it would be better to fix the head to the trochanter. In this we have succeeded beyond our expectations.

I have here a piece of broom handle (Fig. 1) and a wooden ball which I think will illustrate just what is done and

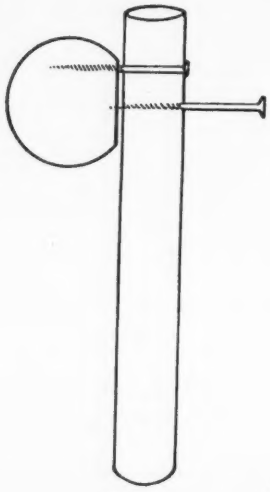


Fig. 1

how it is accomplished. You will see that two screws are run through the handle, which represents the femur, and into the wooden ball, the head. The hole through the handle is large enough to allow the shank of the screw to turn freely, but the minute the thread enters the ball it begins to tighten and bring the ball in closer contact with the handle. The more the screw is tightened the closer the two are brought in contact, the space between representing the line of fracture. If one screw alone were introduced it would act as a pivot and would be of no advantage whatever, but when the second screw is introduced, making the contact even firmer, the head is so fixed to the trochanter that it will move freely in the socket without bringing any strain upon the fragments. This, then, represents the basis of the operation.

The technic is as follows: an incision is made over the greater trochanter about six inches in length to expose the surface, the tuberosity being used as a guide. The tissues are then freed so that the finger may be slipped over or above the trochanter and the neck and head located. An assistant then makes traction on the leg, placing the malleoli in apposition and in what should be the normal position. The foot is then slightly inverted, and with the finger, the neck and head having been located, the direction of the screw (a No. 6 three and one-half inch wood screw) is gauged. It will be found that nearly always a line drawn through the neck will be at right angles to the surface of the shaft of the femur from the tuberosity downward. As soon as one screw has been introduced an x-ray picture is taken, as we find it impossible to do this work with the fluoroscope. If the direction of the screw is correct, a second is introduced, parallel to the first, one inch below, or one inch above the first screw, as indicated by the x-ray picture. The first screw, if not in a position to secure the fragments, is backed out and re-introduced in the right direction. It is best to drill through the trochanter with an instrument just large enough to allow the screw to enter freely. This drill hole should extend to the break, as the thread on the screw must catch in the distal end only. The screw acts as a bolt and the head of the femur as a nut. The tighter this is driven in, the closer the fragments will be brought into apposition and the more closely will they be approximated. The incision can be made either with local analgesia or general anesthesia

according to the condition and temperament of the patient.

After-Treatment.—The limb is suspended in a Hodgen's splint until the wound is healed and the stitches are removed. From ten days to two weeks is sufficient, and though the patient is kept in bed for several weeks longer, no appliance is used. Our cases range in age from fifty to eighty-four. We have been doing this work for less than two years, but have been more than pleased with the results.

I believe that union in an intracapsular fracture is possible at any age if the condition of the patient will permit osteogenesis. Failure is due as often to malposition and mobility of the fragments as to any other cause. One of experience and honest enough to admit failure knows full well that no known method today will assure good functional results in any case and especially in the aged. It is only necessary to note the very small surface of bone to be united, the lowered osteogenetic vitality of the patient and the limitation of callus, to realize the difficulties to be surmounted. It is reasonable to believe, then, that any technic which keeps the fragments in apposition long enough to accomplish the results with the least discomfort to the patient is worthy of our consideration. We have had so far twelve cases: in three, a perfect result; in two, no shortening and excellent functional results; in one, good functional result, and one inch shortening. Three died between the ages of 72 and 84 from senility and cardiorenal complications. Two ununited fractures improved. Two have not been heard from, and two are too recent to report. The encouraging feature is the immediate relief these patients are given after the operation, with free mobility of the joints in nearly all the cases.

We have so far only three cases that we have kept under observation long enough to know positively what the results would be.

Case I—A man sixty-two years of age came to me two months after injury with nonunion and two inches shortening. He was put to bed and extension was applied for ten days, but we did not succeed in pulling the leg down more than one inch. I believed that it would be an error to attempt entirely to reduce the deformity. What I was anxious to do was to get the fragments as nearly in apposition as possible. With an assistant making traction on the limb, the incision was made over the trochanter, the neck of the bone located and two screws were introduced as described above. The screws did not go up to the trochanter. It was my first attempt and I feared to screw them in too far. The leg was then suspended in a Hodgen's splint, but this was of little assistance, as I found the man in a sitting

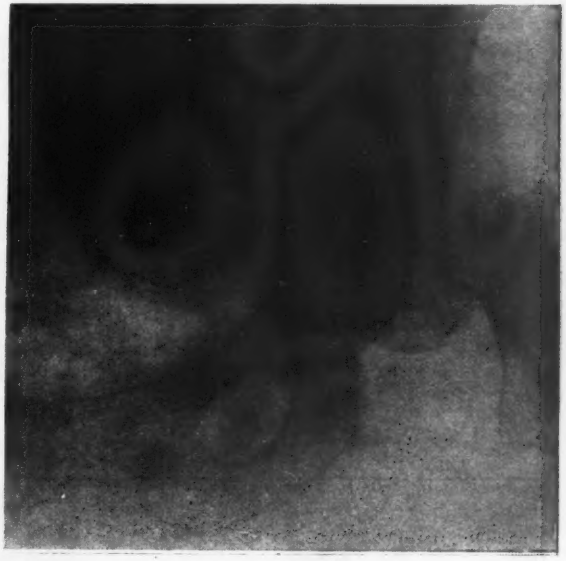


Fig. 2, Case 2
Showing break before application of screws.

position a few days after, with the splint rather a menace than a help. Although the screws were introduced seventy days after the accident, bony union was secured, and though he has an inch shortening, he has a good functional result and gets about with comparative ease.

Case II—The second case is that of a woman fifty years of age, the patient of my associate, Dr. A. C. King. In this case the same technic was carried out. At the end of four months this patient, who had been on crutches for some time, was forced to take up her household duties on account of her mother's illness. She seemed none the worse for it. We have been able to keep her under observation and these slides show the result. You see the position of the screws. There is perfect union, no shortening and almost normal movement of the joint. The first picture shows that

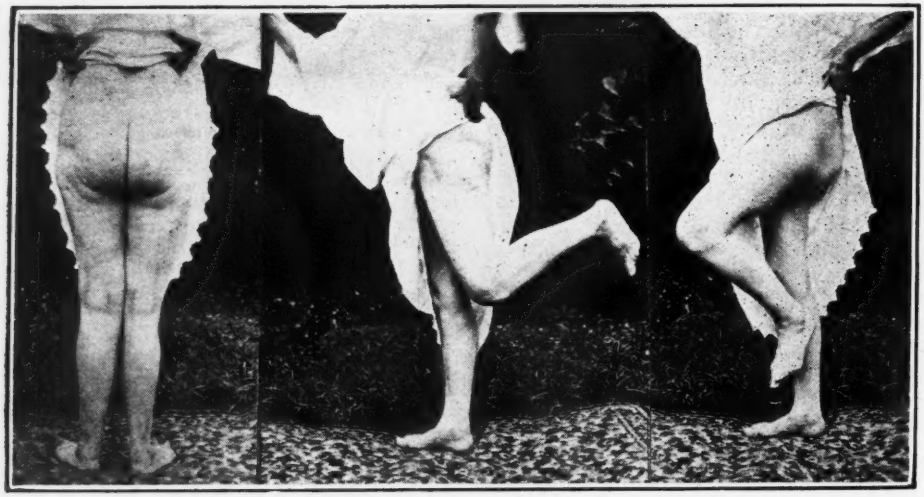
there is no shortening of the leg; the next two. the range of motion. She can walk up and down the steps with the same ease and comfort that she did before her accident (Figs. 2, 3 and 4).

Fig. 3, Case 2
Showing position of head after introduction of screws.

Case III—A woman sixty-four years of age at the time of the accident had a fracture at the base of the neck. Although this was not screwed together tightly enough and a gap was left between the fragments, she has made an uneventful recovery. She has a good functional result just one year after the break. No shortening.

Case IV—Another case was of a woman eighty-four years of age at the time of the injury. We had little difficulty in introducing the screws, as she was exceedingly thin. Ten days after the operation she sat in a roller chair and was able to sit in this chair each day until the time of her death, which occurred forty days later from an attack of diarrhea. Her family permitted me to take at autopsy the head and trochanter. The beginning of osteogenesis was apparent. A piece of bone was taken out by the pathologist to determine the presence of new bone. I feel confident that if this old lady had lived sufficiently long she would have been walking about without the aid of a stick or crutch.

We have learned that the younger the old subject, the more probable the union; that the screws can be easily placed after a little practice, and give the greatest comfort to the patient. One of our patients was eighty-one years of age, and though he lived but three weeks after the operation, he had perfect comfort, was moved in bed without any pain, and in fact scarcely knew that his hip was broken. Two other cases died, one at the end of six months from cardiorenal complications. Another at seventy-six years of age died several weeks later from the



Showing both legs same length one year after operation.

Fig. 4, Case 2
Showing backward motion of leg.

Showing flexion of leg.

same cause. In this case we held out no hope, as we realized the condition of the patient, but she had heard of the results in the other cases and was willing to submit to treatment.

We have tried out this method sincerely. Though we have had but four cases of our own, others have tried it, some with failure, some with success, and they admit its advantages.

Discussion follows paper of Dr. Oertel, page 621.

THE PATELLA WITH REFERENCE TO ACUTE FRACTURE*

By HUGH S. BLACK, M.D.,
Spartanburg, S. C.

The knee, according to Treves, is not only the largest but one of the most important and powerful joints in our anatomy. It is a weight-bearing joint and if its function be impaired from any cause, locomotion is interfered with in proportion to the extent of the injury or lesion sustained. Therefore, there is no injury to which the knee is liable that requires more careful consideration than a fractured patella.

The patella is a sesamoid bone of various anomalies. It is freely movable. The fact that it tends to unite by fibrous rather than bony union after being fractured suggests its sesamoid nature. It develops from the mesoderm. In reviewing the embryology of the knee, one finds that in the differentiation in the articular blastema the patella becomes distinct fourth in order, the first being the meniscus and the last the crucial ligament. The patella develops in the tendon of the quadriceps, remaining cartilaginous until at least the end of the second year, as the apparent center of ossification begins between the third and fifth year. The osseous patella reaches its definite form soon before puberty. The strength of the knee is not in this bone, but is in the quadriceps ligament and tendon. Andrews has shown that the patella is nothing more than a fulcrum to give leverage and does not weaken or strengthen the knee.

The patella may be absent or very slow in its development. Unilateral and bilateral congenital absence of this bone have been reported. When it is absent the knee appears broad and flat and there may be marked impairment of function of the knee or again the knee may be useful.

The infrequent occurrence of osteomyelitis of the patella does not warrant any remarks. It is diagnosed and treated as in other bones. Primary osteomyelitis is rare. The usual cases are secondary to infection of the knee.

Dislocation of the patella may be congenital, spontaneous or the result of a fall or twist of the knee and is more common in the female. It may be dislocated outwardly, inwardly or on its edges. The most frequent dislocation is outward and is due to the fact that the quadriceps, patella and ligamentum patella do not, when the muscle is contracted, follow the lines of the femur and tibia. Patients who complain that the knee gives away and that they suddenly drop to the floor or street without warning, may have dislocation of the patella. If the leg is extended this bone often slips back spontaneously into normal position. If not, the least pressure will replace it, if the leg be extended. Unfortunately, like the shoulder joint, if it is once dislocated recurrences are common. The treatment in such cases is always surgical and consists briefly in the plication or imbrication of the capsule and a shortening of the vastus internus.

The most frequent injury to the patella is fracture. This is comparatively uncommon, as it occurs in the ratio of one to sixty-five to other fractures. The fracture may be transverse, oblique, or vertical. Fractures may be due either to muscular action or direct violence. In the latter the fragments may be severed in any and all directions, depending upon the size and force of the object making the impact. They may be compound and comminuted. In these cases the fragments are frequently held in close apposition by the tendinous expansion of the quadriceps extensors.

The most frequent variety of fracture

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observed by surgeons is seen in the robust individual and results from muscular action, producing usually a transverse fracture. The transverse fracture in these cases is frequently produced by falls, such as stepping from a moving train or car. The leg is strongly flexed upon the thigh while the body is thrown suddenly and forcibly backwards, thereby putting the extensor muscles powerfully on the stretch and breaking the ligaments which, if they overly the patella, cause it to snap. If the ligaments snap above or below the patella, we have a torn capsule without a fracture or without a tear of the fibrous structure which covers it. The synovial membrane in most cases is torn and the patella bursa opened, but it is anatomically possible if the fracture involves only the lower and non-articular portion of the patella and if the separation of the fragments is slight, according to Morris, for the synovial membrane to be saved from injury by the fatty tissue behind the apex of the patella. In all cases where there is much separation of the fragments, the fibrous and ligamentous attachment to either side of the patella is lacerated, which produces an opening more or less U-shaped leading into the joint. This is usually filled with blood.

Little need be mentioned of the symptoms and diagnosis. In the transverse fracture, the change in contour of the knee with the flattened appearance, the characteristic depressed area, the inability to extend the limb and the displacement of the upper fragment are pathognomonic. An x-ray should be made in all cases, even though a clinical diagnosis has been made.

The treatment in cases of separation of the fragments is always surgical. Few advocate immediate operation if the patient is seen within 12 to 24 hours after the accident. Others prefer to wait from seven to twelve days, treating the limb at rest and with ice bags, hoping to prevent further effusion of blood into the joint and to give Nature a chance to increase the tissue resistance to infection. The injection of 2 per cent formalin and glycerin as advocated by Murphy is not essential. His idea is to produce a coffer damming of the lymphatics, so to speak, as an immunity to the joint against infection.

The transverse, vertical and U-shaped incisions have been advocated. The latter gives the best exposure of the patella and permits the easy removal of blood clots by instruments, not fingers, and allows for the freshening and removal of the ends of the sheath of the ligamentous tissue and torn capsule which prevent the fracture from uniting. The internal and external ligaments should be carefully sutured with interrupted chromic catgut. Some surgeons advocate the use of beef bone screws, plates, wiring, etc., to bring the fragments together. This is not essential, for if the ligamental tissue and periosteum overlying the patella is sutured with interrupted chromic catgut either as an end-to-end anastomosis or by overlapping methods, functional results with the knee might be secured. This is all one can ask. Rugh has called attention to the necessity, carefully and accurately, to close the capsule at the lower edge of the two fragments to prevent tilting.

The suturing should always be re-inforced with a purse string of kangaroo tendon, bronze or silver wire surrounding the entire patella and passing through the tendon above and the ligament below. Especially should this be done in comminuted fractures. This suture, according to some, is not necessary, but it certainly makes one feel safer. The acute fractures without separation are best treated conservatively by figure of eight bandage or adhesive straps. The compound fractures must be treated upon their own merits.

The most important step in the operative treatment of fractures of the patella is early, active and passive motion, carefully moving the knee the day after operation. It is said that movements increase the circulation to this area and if this be true, repair should take place more rapidly. The fixation of the joint by the application of a cast or otherwise tends to produce more or less stiffness of the knee for a long time and materially interferes with locomotion. After the removal of the stitches, usually on the fourteenth day, the knee should be massaged daily and the patient should be allowed to be up and about with the aid of crutches or a cane. In some of the chronic cases with marked separation of fragments, the von Bergman operation, fascial transplant, etc., may be necessary if the fragments cannot

be brought in apposition. In recent fractures this is not necessary.

From some six or eight cases which have come under my care, I will report briefly only one.

A traveling salesman, aged 36, weight 225 pounds, height 6 feet 2 inches, consulted me about an injury to his knee of six or eight hours' standing.

Examination revealed a transverse fracture of the patella with marked swelling, ecchymosis, and tenderness over the knee. He was unable to extend the knee or walk forward, but could walk backward as is usually the case in this type of fracture. The patient was put to bed with the limb extended and ice bags to the knee for ten days. Twelve days after injury a U-shaped incision was made reflecting the flap upward, exposing the patella fragments with separation of the lateral ligaments. Blood clots were removed, the wound was irrigated with saline solution, and the edges of the periosteum and fascia which was lying between the fragments freshened. The lateral ligaments and the periosteum and fascia overlying the patella were sutured with interrupted chromic catgut. This was re-inforced by a purse string kangaroo tendon surrounding the entire knee cap. The day following the operation slight movements were made in the knee and this was increased daily until the twelfth day, when the patient left the hospital walking with a cane. The knee was massaged daily for about four weeks, at the end of which time he had good flexion with a normal functioning knee.

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Discussion follows paper of Dr. Oertel, page 621.

FRACTURES OF THE LARYNX*†

By T. E. OERTEL, M.D.,
Augusta, Ga.

Fractures of the larynx are rare. This evidently is due to the situation of the organ, it being protected by the overhanging chin, to the flexibility of the surrounding structures and to the resiliency of the cartilages that make up the walls of the larynx itself.

Hoffman has collected a series of 124 cases, 63 of which were fractures of the thyroid and 17 of the cricoid alone. Shurley says:

"Henocque collected and published the observations in 52 cases of fracture of the larynx: of these, 23 were of the thyroid, 7 were of the cricoid, and 7 were of the cricoid and thyroid simultaneously. There were 19 deaths in all. Those cases where the cricoid and thyroid were both implicated were fatal. Fracture of the cricoid is usually fatal. So far as ascertained, the cause of these deaths was asphyxia or general emphysema.

"Dr. H. Fussell collected and tabulated 70 reported cases, showing 54 deaths. Compound fractures of the larynx are sometimes met with, and are always grave cases. They are usually much oftener fatal than an incised wound communicating with the neck.

"Dr. E. L. Bell (*New York Medical Record*, March 28, 1896, p. 458) of New Hampshire, reported an interesting case of compound fracture of the thyroid cartilage (the result of an attack by a bull) which recovered. The patient was 29 years old. The wound was a large, lacerated one, in which all the muscles of the neck covering the front and right side of the larynx were very much torn. The two alae of the thyroid cartilage were entirely separated. The right ala had a longitudinal fracture, the cricothyroid membrane was lacerated, and the cricoid cartilage badly bruised. The hemorrhage at first was quite severe. The wound was thoroughly cleansed with sterile solutions of water and a solution of mercury bichlorid, and the outside parts were aseptically dressed. The wounds healed nicely. There was not much dyspnea and the patient recovered his voice. No tracheal tube was used.

"Dr. C. M. D. Goldos, of Havana, reported an interesting case of fracture of the laryngo-trachea ending in recovery with a good monotone bass voice. He thought the phonation was produced by the ventricular bands taking the functions of the vocal cords. Singing and crying were impossible in this case."

Delavan recites a case of fracture of the larynx from hanging, with cut of the cricoid membrane and recovery. In this case it was necessary for the patient to wear a tracheal tube for the rest of his life on account of stenosis due to multiple fracture of the thyroid cartilage.

Lederman reports a case of fracture of the larynx of a boy who, while riding a bicycle, was struck on the larynx by the tongue of a wagon. He could find no great amount of literature on the subject. There was dislocation of the thyroid cartilage, the arytenoid spaces being swollen and some shreds protruding from the larynx below the vocal cords that he took to be a piece of cartilage. He was completely aphonic after the injury and suffered some dyspnea. There was considerable hemorrhage after injury. Treat-

*From the Laryngological Department of the University of Georgia.

†Read before Southern States Association of Railway Surgeons, Auxiliary of the Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

ment consisted of rest and cold. Lederman says:

"These cases are rather rare. I find few on record. I found one man stating that in fractures of the thyroid cartilage mortality was 70 or 80 per cent, saying further that in fractures of the cricoid cartilage the mortality was almost 100 per cent due to stenosis or conditions causing stenosis, and he advised in every case an immediate tracheotomy."

Lederman later reported on the same case, which made a good recovery and could use his voice in moderation without becoming aphonic.

Hawes reports the following case:

A youth, age 19, was struck over the larynx by a foul ball, after which he had severe pain and intermittent attacks of aphonia, due to anterior fracture of the thyroid cartilage. An operation was required to unite the fracture. The operation was a success and the voice was permanently restored.

Clark attended a case in which death resulted from fracture of the thyroid with a tear of mucous membrane between the true and the false vocal cords. Death occurred suddenly some hours after the injury.

"He is reported to have slept well during the night, but next morning, about 6:30, after coughing a few times, he suddenly ceased breathing. The history shows how slight and uncertain may be the symptoms produced by a grave injury to the larynx."

Downie reports four cases, with one death. He is of the opinion that a fracture of the thyroid alone is much less serious than a fracture which involves the cricoid as well as the thyroid. Edema, emphysema and suppuration are complications which may supervene and may lead to serious consequences. In his cases there was edema of the laryngeal mucosa. In two cases there was suppuration resulting in the formation of large abscesses in the neck and in one case there was emphysema. One of his cases was caused by a violent sneeze with the head turned sharply to one side.

Within the past few months I have treated two cases of fractures of the larynx, the only ones I have seen during a practice of twenty-five years. The histories follow:

Case I.—February 10, 1923, Harry Carthan, aged 24, a colored laborer, was using a car jack in the Georgia Railroad Shops when the pawl slipped and the handle of the jack flew upward, striking his larynx with great violence. For a few moments he was unconscious, and on regaining consciousness there was intense pain and dyspnea, cough and hemorrhages. He was given first aid by Dr. Traylor, one of our local surgeons, who sent him at once to the University Hospital and notified me. I went immediately to the hospital and found the man, a very robust and muscular individual, in great distress. Every few minutes there was paroxysmal cough with expectoration of quantities of bright red, slightly frothy blood. The temperature was 99, pulse 110, and respiration 24. He was very restless and tossed from one side of the bed to the other. The region of the larynx was greatly swollen and exquisitely tender. I had him removed at once to the operating room and did a tracheotomy under novocain anesthesia. No difficulty was experienced until the trachea was exposed. I then made an error that almost cost the patient his life. Somewhere I had read that before opening the trachea it is well to inject a few drops of anesthetic within its lumen in order to avoid reflex following division of the cartilaginous rings. With this in view, I passed the needle between the rings into the trachea and injected a small amount of novocain solution. Immediately there followed severe spasmodic cough, the patient began to writhe and to cough blood, so that both my assistant and I were covered with it. The hemorrhage was so free that he was rapidly choking, and death seemed imminent. While trying to hold him on the table with my right hand I picked up a knife in the left and, locating the trachea by sense of touch alone, made an incision into it. A slight twist of the blade gave him air and he soon became quiet enough for me to insert a tracheal tube. (I shall not again try the intratracheal injection.)

Careful palpation of the larynx gave a sense of crepitus over the right side of the thyroid cartilage. He left the table in good condition.

The tube was removed on the fifth day and he left the hospital on the eighth. Treatment in the hospital following operation consisted in absolute rest with an ice bag to the larynx for the first few days. On account of pain on extension of his tongue I was unable to get a view of the interior of the larynx until the tenth day after the injury. At this time I could see a rupture of the mucous membrane traversing the larynx on the right side just above the ventricular band. The wound was granulating, but still at one point there could be seen an edge of fractured cartilage. The patient was kept under observation for several weeks. He made a slow but uneventful recovery and regained a normal voice.

Case II.—April 2, 1923, John Henry Harris, age 24, a negro laborer, who worked for the C. and W. C. Railroad, was helping unload steel rails from a car. One of the rails fell on the end of a crow bar, the handle of which was thrown up. It struck him across the region of the larynx and, as he expressed it, "It knocked the breath out of me and I spit up a lot of blood." I saw him a few hours after the accident. There was a contused wound on the right side of the throat cor-

responding to the location of the thyroid cartilage and swelling was moderate. Palpation gave a feeling of softness over the right side of the thyroid, but no crepitation could be made out. Examination with the mirror revealed a swollen epiglottis, which was sharply bent to the right. Within the larynx on the right side there was a tumefaction which reached the arytenoid above and covered the lateral wall. A similar condition on the left, smaller and lower down, almost closed the larynx. The cords could not be seen. There was no further hemorrhage. He was able to speak in a very husky tone. He was sent to the hospital. On admittance his temperature was 98.6, pulse 70, and respiration 26. Rest and ice to his throat were ordered. I considered doing a tracheotomy, but his condition was so good that I decided against it. He improved rapidly and was dismissed from the hospital on the fourth day. Two weeks later there was no further tumor within the larynx, but a total paralysis of all the muscles on the right side persisted. This probably will be permanent.

In both of my cases there was sudden and extreme violence. Escalada determined that in general a pressure of 55-80 kilograms was necessary to fracture the larynx, the force required varying with the age and consequent calcification of the cartilages.

Garel quotes Vitalba, who has compiled a few cases of sudden death from concussion of the larynx, and Bassere, who has reported an instance of prolonged inhibition of the respiratory and cardiac nerve centers after concussion of the larynx, unconsciousness persisting for nine hours with Cheyne-Stokes respiration and slowing of the pulse down to 40, at which rate it continued for three weeks. In one of these cases hemoptys's persisted for several months. They warn against being misled by the apparent good condition of the patient. Even several days after the accident there may be sudden asphyxia from acute edema, secondary hemorrhage or displacement of some fragment of cartilage during an abrupt movement. Even contusions may affect the voice irreparably.

From the foregoing we see that all who have dealt with fractures of the larynx consider the condition one of great gravity. Keen advises tracheotomy as soon as a diagnosis is made, even though cyanosis and dyspnea be only of moderate degree. Doubtless this advice is sound. Other than this ice packs and rest with symptomatic treatment are the only means at our command. The tracheotomy tube may be removed when edema has subsided, probably in most cases at the end of a week. The patient should be cautioned against voice strain; in fact, should use only moderate tones for some weeks following clinical recovery.

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DISCUSSION--SYMPOSIUM ON FRACTURES

Papers of Dr. Black, Dr. Martin and Dr. Oertel

Dr. C. D. Christ, Orlando, Fla.—Most cases of fracture of the hip joint occur in old people because of the atrophy and laxity of the muscles around the hip joint incident to advanced age. In Dr. Martin's series of twelve cases, his mortality rate was 33 per cent, his bad results were 33 per cent, and his cures were 33 per cent. In my opinion, his absence of selection of cases for operation was a grave error. Other methods of treatment in these cases would have given better results and lessened the mortality rate.

To put old people in a plaster cast is, as a rule, a most inhumane thing. I have obtained best results by putting these people to bed, holding the limb in the best obtainable position by sand bags, both along the inner and outer side of the thigh, and elevating them to an angle of 45 degrees, thereby giving the maximum amount of comfort. In the treatment of eight cases, all of which occurred in one winter, I had but one death. This man was 69 years of age, in very bad health generally and died about the fifth day following his accident. The rest of these cases, ranging from 65 to 87 years of age, made splendid recoveries and were all treated by the sand bag and elevation method. Three of these patients were able to walk without the aid of a cane or crutch in three months' time.

I think the operative treatment in selected cases is very excellent, but I make a plea for the careful selection of cases for operation.

Dr. E. T. Newell, Chattanooga, Tenn.—At the meeting of the American College of Surgeons in Chicago Dr. Magnuson operated upon two cases of patella fractures such as Dr. Black described and used ordinary stove wire. He said that by the use of stove wire, boring into the upper fragment and then coming down and burying it under the quadriceps tendon, he was able to get his patients up within three weeks and let them exercise. The consensus of opinion of those who saw him do this believed that chromic catgut, as recommended by Dr. Black, was preferable. Of course, if the lateral ligaments are not torn ex-

tensively or there is only a slight tear, you do not need much of anything. It is the lateral ligaments that do the most in reparation and give the best union.

Most authorities claim that you can get firm union in only about 70 per cent of patella fractures. In operation the first step is to open up with the U-shaped incision and remove the blood clot. Some men flush out the joint cavity with ether. They bring the fragments together, evert the edges of the capsule, suture with chromic catgut and get splendid results.

Some say it is best to wait ten days before operating. Others operate immediately. In the last seven cases I have operated within twenty-four hours and have had results as good as in the cases where we formerly waited ten days.

In regard to fractures of the neck of the femur I think with a mortality of 4 cases out of 12 we should not let Dr. Martin's remarks go unchallenged. He did beautiful work with an ordinary wood screw. I think he is confining this to fractures of the anatomical neck that do not heal so well, and that it is very applicable to these. In 75- or 78-year-old patients I get the best results as to abduction and flexion, not by sand bagging, as Dr. Christ suggested, but with the improved Thomas splint and Balkan frame. The patients can use the bed pan, move all around in bed, and get a good deal of exercise.

I believe that except in specially selected cases, the use of the Thomas splint with the Balkan frame and all its new attachments is the method of preference.

Dr. Hermann B. Gessner, New Orleans, La.—I know it is strange that 4 out of 12 of Dr. Martin's patients died. I happen to know about two of them. One, an elderly woman, was in extremely bad health, with a bad heart, and there was a hard struggle in that case. Another, an old gentleman, was also in very bad health. Both would very probably have died under any treatment.

I wish to say something in behalf of the Whitman method that has been attacked today. I am having my fourth satisfactory result with the Whitman method. My last patient is walking about with a stick after seven months. I think that is quite satisfactory. I have been using a modification of the Whitman method that I first saw applied in Baltimore some years ago by Dr. McGlannan, working with Dr. Bloodgood. It consists in putting up the thigh in abduction with the knee flexed. These patients are much more comfortable and they can be looked after much better than if there is abduction in extension. This position also permits them to sit up in bed.

I keep my patients in that position for at most six weeks. Before that time is up I remove part of the plaster and let them flex the sound limb and some time about the end of the fifth week I take off the front of the plaster shell on the injured side and let it have some passive motion. At about the same time I take off the plaster from the abdomen and let them sit up. I think the plaster method is not so inhumane as we have been led to believe. The Whitman method will give excellent results if it is properly carried out.

One point to remember about all operative work on bones is that it must be done in a hospital with superaseptic technic and with a team of assistants who are accustomed to this work.

A Member.—I like Dr. Martin's work very much. I have used the same method, but have had slightly better results, not because I am a better surgeon, but because I take better cases. His old men would probably have been better off if he had used the sang bag method. Whatever you do for the intracapsular fracture of the hip joint is done for one thing: to get the position and maintain it. Spiking the bones together is not difficult. It can be done under local anesthesia in those cases that are flexed. If you talk to your patients all the time to distract their attention, they do not object when you put the screw in. The wounds were all healed long before any of Dr. Martin's patients died. He did not add anything to their burden. Let us take them off him and say that he got excellent results.

As to Dr. Black's paper I, like Dr. Newell, operate as soon as I see the case. I think there is no way in which waiting can help. If a man is over-timid at surgery he should be doing something else. See that you approximate as closely and as carefully as you can. Weave in the kangaroo tendon and bring the pieces so close that you yourself cannot see the cleavage in the bone. The difficult case is the one where you have no bone on one side, where you have the knee cap above and only the quadriceps tendon below. The next most difficult case is the stellate fracture, where a man is running and falls and strikes his knee on the ground or the sidewalk and has five or six pieces of patella. If you weave it around and around and make it smaller with kangaroo tendon you can get a good result. Let them use crutches if you wish in 72 hours. They will take care of the knee. All you have to do is to put on a stiff starched bandage yourself. Do not leave it to the hospital interne, for he will put on eighteen or twenty pounds of gypsum. It is cruel to turn a man out that way and you cannot get a good result.

Dr. C. P. Gray, Monroe, La.—Dr. Martin did not tell you to operate upon this, that and the other case. The principle that he was trying to instill was that these screws should be used in selected cases; in other words, to bring an apposition of the bones. One screw went in one way and one another, one going at a different angle from the other.

As I understood it, Dr. Martin is trying to bring before us the message that bone tissue is kindly. He uses the screws because when the tissues pull in opposite directions they hold it together. Why not use a nail? In the cases where there is cancellous tissue if the artery is not destroyed probably pounding in the nail would injure this. But the main lesson in Dr. Martin's paper is that, whether it is a nail or a screw, anything that pulls this femur over and holds it in apposition until healing can take place will

permit it to unite. In addition to that, his method gives the patient a great deal of comfort. There are cases in which it is necessary to put the leg up in a modified Thomas splint or with something more than a sand bag on the opposite side of the thigh. By putting a sand bag on the outside and one on the inside of the thigh, with only modified traction, and no band, in some cases you will get good results. In the type of case Dr. Martin mentioned his work is above reproach.

Dr. D. M. Higgins, Gainesville, Tex.—I remember seeing Dr. Murphy some years ago drive in a nail where Dr. Martin puts a screw. We all thought this was great and we went home and tried to do it and some of us were sued. I like Dr. Martin's work and I use his bands whenever I can, but I do not believe I will ever follow him with his screws. I get good results by the plaster cast, and do not find it inhumane. If you put on a proper cast, after the first twenty-four hours your patient will be perfectly comfortable and happy. You do not have to keep them on their backs and you can begin to take the plaster away in a few days. If they complain that they cannot eat enough and want the spica off their stomach, I take it off. We have good functional results following this treatment, with very little shortening. Most of the people are old; they do not expect to play football or tennis or go on the athletic field, but they are comfortable.

In my experience it makes little difference whether you repair patella injuries immediately or after four or five days if it is done properly. I use kangaroo tendon. I have some cases that want to be operated upon at once and I do it with good results. I avoid wire and use kangaroo tendon altogether, particularly on the patella. I take care of the capsule, put them in a plaster splint for a few days and then take it off and let them go.

Dr. J. S. Stone, Boston, Mass.—I think the Whitman method in treating fractures of the thigh is coming into vogue very strongly. In some of the very old patients the chance of getting them well by any method that we can adopt is slight. My feeling is that the less hardware we put into the bone tissue, the better. On the other hand, there are certain advantages in the malleable wire that does not break, but has tensile strength.

Dr. Martin (closing).—The patella is just as important in the function of the knee joint as any other part. In a flexed knee, the patella rests in contact with the condyle of the femur at all times and at every angle. If the knee is acutely flexed and the tendon rests close to the condyle instead of being held apart by the patella, no power on earth can extend the leg against the slightest resistance. The patella, though in contact with the condyle, is raised above it, and the power, before it is applied to the leg at the tibial tubercle, is transferred through the patella, which acts as a fulcrum. Therefore, to obtain a hundred per cent result, we must absolutely restore the patella to its normal condition.

To restore it temporarily is easy and can be done by any operation which keeps the fragments in perfect apposition long enough. Herein lies the difficulty. Because a useful limb, for the ordinary purpose of walking, is gotten by almost any operation, surgeons report their results as good. But to get a perfect result the patella must be restored, as I have said, to its normal condition. If this is done by suture of the capsule, for it cannot be done by any except open operation, for one year at least the patient has to be exceedingly cautious not to put any unusual strain on the joint. About 65 per cent of all refractures occur within the first year. In 1900, I first began work on fractures of the patella and finally hit upon the technic now followed out in all cases.

After carrying out the same technic as is done by the open operation of suturing the capsule, I introduce a piece of No. 19 annealed iron wire through the tendons just as close to the patella as possible, likewise through the ligaments below, using a heavy curved needle and taking a deep bite into the tissues. The wire is now drawn tightly over the top of the patella and the ends are twisted, cut and buried between the fragments. Now we have an internal splint. The leg is kept in a suspended splint until the wound heals, the patient is then put on crutches and in a remarkably short time has the use of the limb, without the fear of refracture, and, I may add, the necessity of massage. The patella is a sesamoid bone, very porous, and it takes six months or more for firm union.

All over the world today we have old people bedridden from fractures of the neck of the femur. I have accomplished something that other methods have failed to accomplish. It is gratifying to know that none of the surgeons present are responsible for the failures I have mentioned.

It has occurred to me that in cases of fracture of the larynx intubation might help, the tube acting as a splint to support the parts and prevent obstruction and dyspnea.

ROENTGEN DIAGNOSIS IN UROLOGY*

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and
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Each year with the advent of better instruments of precision and greater experience, the science of radiology is becoming more exact and the profession is depending more and more upon radiographic evidence for diagnosis. This

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progress is probably most noticeable in the field of urology. Only a few years ago the demonstration of calculi constituted about the only use of the x-ray in this specialty. Today, in addition to a study of calculi, the pelvis of the kidney is carefully examined, and the size and contour of the ureter and bladder are carefully investigated by the radiogram.

We feel that the fluoroscope has a very limited use in urology, so we confine our remarks entirely to radiographic studies.

It is hardly necessary to say that the location of calculi is still of the greatest importance. By the plain 14x17 film made on the Buckey-Potter diaphragm showing the entire urinary tract, at least 96 per cent of the calculi should be shown; and by this technic with an opaque catheter in the ureter even a higher percentage ought to be demonstrated.

We find it extremely valuable in locating and following the descent of ureteral stones during treatment for removal by the injection of novocain and oil as devised by Dr. Crowell. And in dilating the ureter to deliver a large stone it is often important to get the relative positions of the dilator and stone while the patient is still on the table.

It is often necessary to use the pyelogram and by combing with this an exposure at two angles the shadow may be more definitely located. We feel this is generally more valuable than a stereoscopic study.

Anomalies in the urinary system occur rather frequently. Different observers have reported between 2 and 4 per cent. When one looks for them it is surprising how often they will be found. The higher percentages were doubtless found at autopsy, since it is evident that most anomalies would not give the slightest symptoms. In a recent analysis of 500 cases we found only 7 anomalies, or 1.4 per cent.

For study of the size, shape and position of the pelvis and for locating a stone in the pelvis we must use either a denser medium, as sodium bromid or thorium, or a medium less dense than the kidney, as oxygen. We have used 20 per cent sodium bromid and have found it very satisfactory as far as the radiogram is concerned.

It is important, as has been shown by Todd and Thompson (the *Journal of Urology* September, 1922) that the pressure be very carefully watched and the fluid injected very slowly. We do not hesitate to say that it is not so satisfactory to the patient, for even if it is withdrawn quickly and the pelvis lavaged with physiological salt solution, the patient experiences a great deal of subsequent pain. Dr. Todd has also shown that this pain is very decidedly decreased if the pressure is not allowed to go above 50 mm. of mercury. The reaction is generally either absent entirely or lasts only two to four hours where previously it lasted twelve to fifteen hours. On account of this discomfort to the patient in many cases for study of the pelvis we are using oxygen by means of Bayeux's oxygenateur. The oxygen is injected to a pressure of 50 cm. of water, or about 38.5 mm. of mercury, and is quickly expelled or absorbed and causes practically no subsequent pain in so far as we have been able to determine and no damage to the kidney.

In cases where it is necessary to study the ureter the sodium bromid is more satisfactory, for it gives a better contour and remains in place longer for the radiographic study. Constrictions, kinks and dilitations of the ureter are very easily demonstrated by the sodium bromid ureterogram.

The bladder is generally as a routine examined in connection with the kidney and ureter. The cystogram is often of great service in demonstrating tumor, both extrinsic and intrinsic. Diverticula are not infrequent and occasionally are shown by cystograms when they cannot be definitely seen by cystoscopy.

In conclusion, we have attempted, in a very elementary way, to indicate some of

the advantages gained by radiographic examination of the urinary tract working in conjunction with the urologist, and to show a few interesting cases. We may fully expect to see other uses developed.

DISCUSSION

Dr. John Armentrout, Roanoke, Va.—This paper and the lantern slides show the advantage of using the Buckey diaphragm, by which means can be obtained the entire urinary tract on the plate with all the anomalies in either right or left side. This work illustrates what can be accomplished by thorough cooperation between the radiologist and the urologist.

Dr. R. B. McIver, Jacksonville, Fla.—In our service at the hospital—I represent the surgical service—we do not attempt to do anything for the patient without the cooperation of the roentgenologist, urologist and surgeon. This exposition this afternoon brings out the advantage of cooperation between what should be a single service. The surgical service should include the x-ray.

I should like to ask the Doctor as a matter of interest what is the largest stone he has been able to get in his Clinic by mechanical means as opposed to surgical intervention. Just the week before I left home there was a case of bilateral calculus which came into the hospital. One kidney had been explored and a quantity of stones removed from the pelvis. The patient came back with similar symptoms and a stone ½x¾ inches was seen to be imbedded in the lower ureter. The patient was 64 years old. He wanted to be operated upon because of his symptoms. I was opposed to operation on account of the physical examination. We gave him one treatment which was of doubtful value. We did not get the catheter by the stone, but to my great surprise he passed the stone. Before that time the largest stone we had gotten was much smaller than that.

A Member.—I am interested in asking Dr. Lafferty a question about something that has been bothering me a good deal in the last few years, namely, the interpretation of ureterograms. We see the ureter a good many times at operation during the course of laparotomy in patients who have no urinary disease and in such cases the ureter generally appears to be a rather slender organ, not over 6 or 7 mm. in diameter. Also at autopsy it usually appears about that size. I have been interested in determining the distensibility of the ureter. I have investigated perhaps sixty or seventy ureters at autopsy, and except in children have found that the ureter can be distended by the pressure which you ordinarily use in doing a pyelogram, that is, with the gravity apparatus and the fluid elevated about two or three feet above the patient's level. If that is true, I was wondering what interpretation we should give to ureters which are evidently larger than those on the radiograms. Of course, the etiology of these cases can be determined later by the clinician, but if they are dilated I think they ought to be noted in order that the condition may be properly handled. If the ureter is not functioning, the kidney does not function either. I am asking this merely for a point of information.

Dr. W. P. Whittington, Asheville, N. C.—Long before we had the advantages of radiography we met with a great many cases of urinary colic, so-called urinary gravel colic, and by alkalinizing the urine, many of these stones were made to pass without the use of a surgical operation or dilatation. I would like to ask Dr. Lafferty just what the best method is for alkalinizing the urine.

Dr. A. L. Gray, Richmond, Va.—Dr. Lafferty stepped on a rather tender corn when he referred slightingly to fluoroscopic examination of the urinary tract. I think the reason more of us do not employ the fluoroscope in these examinations is that we have not tried it, at least under favorable circumstances. Except in very heavy individuals, with a good fluoroscope, one can see almost any stone that is visible as definitely as a calculus on the plate. One cannot go from a brightly lighted room into a dark room and see the stones. It is, of course, necessary to prepare the eyes by remaining in this darkened room for some little time.

It is our custom, if we intend to make a pyelogram, to have the urologist introduce his catheter and then take the patient into the x-ray room. We examine the patient by the fluoroscope to see what the position of the kidney is. Then we watch the dilatation of the pelvis with the opaque medium and when we ascertain that the pelvis is properly filled, the flow is either shut off or the pressure of the distending fluid is stopped (we use the gravity method) until the plate is put in the proper position. Then the pyelogram is made. Personally, I obtain a great deal more information from watching the pelvis of the kidney fill and from watching the course that the distended ureter takes under the fluoroscope than I do from the plate. Of special value is the use of the fluoroscope in determining the relative positions of the opaque catheter and a calculus, or the position of a dilator when one is used. Why subject the patient to the rather long, tedious procedure of making a Potter-Bucky diaphragm plate in order to obtain the information that you wish, when one can examine the relative positions of the dilator and

the stone in two minutes? I again want to ask the gentlemen to try fluoroscopy and I am sure they will continue to use it.

Dr. Lafferty (closing).—In regard to Dr. McIver's question as to the size, I cannot give the measurements. They look very big when they first come out. I recall that the other day Dr. Crowell came in with one about three-fourths of an inch long. As a matter of fact, there are not very many big stones that are so easily removed as that. I think in the last 160 that we have treated by oil and novocain we failed to get seven stones. It is surprising sometimes how easily stones, when they are nicely shaped, will slip through after a little lubrication. Again it is surprising how a stone that looks as though it would slip out will get caught in one of the constrictions and it will take dilatation sometimes with a metal dilator to get it by the last place into the bladder. We have had one or two that were caught in the urethra and finally had to be delivered by forceps from the urethra. It is surprising how they got through the ureter.

In regard to the dilated ureter referred to, there are, of course, various degrees of dilatation. We see various sizes. The normal is about the size we find at autopsy, that is 6 or 7 mm., with a few narrow sections. I feel pretty sure that a good many of our ureters that we find larger than normal have been caused by some previous trouble. Those of you who have followed urological work know how frequently you will find some kidney lesion in patients who have been operated upon for appendicitis without any relief. Any ureter that is dilated or that appears to be larger than we are accustomed to see should be watched carefully and the secretions examined to see if the cause is higher up or to see if it is due to some kink or obstruction lower down.

The dissolving of stones by alkalinizing the urine is possible if it is a cystin stone. These cystin stones will dissolve in alkaline urine as indicated in this one little series. The drug we used was just ordinary sodium bicarbonate for making the urine alkaline.

In regard to the fluoroscope, Dr. Gray is probably right, as he usually is, and probably the reason we do not use it more is that we do not have a good place in which to do it. That is the real reason perhaps that we do not use it in looking at the dilator. As he says, to see those stones easily one has to stay in the dark for fifteen or twenty minutes or more before being able to do much in the fluoroscopy of the urinary tract. While the dilatation is being accomplished one is able to develop the plate. One of the best uses for the fluoroscope, namely in the operating room, is when there is one of those elusive kidney stones and when the kidney is held in the hand and yet one cannot locate the stone. I believe at the Mayo Clinic they use the fluoroscope with the kidney in the surgeon's hands and let him locate it that way.

EYE, EAR, NOSE AND THROAT

REMOVAL OF INTRA-OCULAR FOREIGN BODIES*

By NORMAN M. HEGGIE, M.D., F.A.C.S., Jacksonville, Fla.

It is the desire of the author to call attention to the wide diversity of opinion that exists on this subject, with the hope that discussion will result in a greater degree of uniformity of opinion. Some recognized authorities have said: "History of the injury should be disregarded,"[1] while others,[2 3] with whom I agree, believe the history helpful. But the history should under no circumstances be viewed in any sense than as an adjunct. Though it be of no material help in obtaining the result desired, it is certainly of assistance to the student of the future to know all the circumstances that influenced the selection of procedure. To record it is a duty we owe him.

At a meeting of the American Medical Association in St. Louis in May, 1922, a prominent oculist quoted a case in which the history caused an intra-ocular foreign body to escape his notice. In my own practice I recall a case in which the foreign body was so small and the wound of entrance so obscure that these facts in conjunction with the history by the patient caused the family doctor and an oculist to overlook a foreign body that had penetrated the cornea and lodged in the iris. Such cases prove merely Dr. Derby's[5] contention that "in every injury of the eye the possibility of a foreign body in the eye should be considered." There is still some slight difference of opinion as regards not the desirability but the necessity of localization. However, it is the consensus of opinion that position of the foreign body should be determined as accurately as possible.

The position of the patient at the time of the removal of the foreign body is rarely mentioned in articles on this subject. Dr. H. D. Bruns[6] thinks the patient should never be laid on a table or put with head against an immovable head-rest. I am entirely governed by the circumstances of the individual case and do not recall a single unfortunate result that could have been attributed to position, though I have removed intra-ocular foreign bodies with patients in each of the positions to which Dr. Bruns objects. Until this year we have not had a giant magnet at any of our hospitals and all of the foreign bodies mentioned in this series of nearly thirty cases were removed at my office with a Victor magnet. If under a general anesthetic, the patient was always laid on the table. If under a local, he assumed the position that seemed most desirable in the particular instance.

The route of removal, i. e., anterior or posterior, offers the greatest field for difference of opinion. Men of prominence and large experience have preference for the anterior route as the rule and use the posterior only in exceptional cases.[5 3] Others of equal experience select the posterior as the route of election, using the anterior only in exceptional cases.[5 7] Some, apparently have no preference.[4 2] I have had much better results in using the anterior route. In a general way I cannot better state my opinion on the subject than by quoting Dr. G. S. Derby:[5]

> "The anterior route is the method of choice except in cases of large foreign bodies where the lens is uninjured. The posterior route is employed in comparatively rare cases where the intra-ocular foreign body is so firmly fixed posteriorly that it cannot be drawn forward."

Dr. Patton[4] states that in his experience the eye tolerates copper or brass more kindly than other non-magnetic substances, and there is a tendency for this type of metal to work its way outward through the coats of the eye. Dr. A. M. Ramsay,[8] of Glasgow, says:

*Read in Section on Eye, Ear, Nose and Throat, Southern Medical Association, Seventeenth Annual Meeting, Washington, D. C., Nov. 12-15, 1923.

"Leber has shown that copper is particularly dangerous even when it is quite free from micro-organisms, for it always sets up destructive inflammation as a result of chemical reaction."

Probably no one of us has a sufficient number of non-magnetic metallic intra-ocular foreign bodies from which to draw reliable inferences, and it is only from the combined experience of many operators that reliable data can be compiled.

I recall a case at the Presbyterian Eye and Ear Hospital in Baltimore, in the clinic of Dr. Hiram Woods, that resembled that described by Dr. Patton.[4] A piece of cartridge shell had been in the eye about five years, eventually escaping through the sclera. In my own practice of twenty-one years I recall only two cases of intra-ocular foreign bodies of brass. In each of them I made an unsuccessful attempt to remove the brass. In one I enucleated the eye under the same anesthetic. In the other Dr. Fox eviscerated about a week later. Even if we are faithful in recording and reporting non-magnetic metallic foreign bodies in the eye, the prospect is not bright for reliable data on the resultant action. If the eye escapes removal at once on account of infection, or if the destruction *per se* does not demand removal, or if for cosmetic reasons it does not seem advisable, there still remains the dread of sympathetic ophthalmia. Thus there are few eyes so injured that are not removed at once.

One of the most outstanding features connected with this subject is the absence of infection carried to the interior of the eye by the foreign body. Fortunately we need not concern ourselves to account for this fact, which seems to be a universal experience.

Disturbance of the vitreous is to be avoided if possible, but if the external application of the magnet has not produced the result desired I have not hesitated to introduce the tip and I know of several cases in which the foreign body was so removed that showed no evidence of responding to the magnet applied to the wound.

One of my confreres, Dr. Sandusky, assisted me last month in a case that illustrates the point. The magnet was applied to the wound and the current switched on and off repeatedly without any apparent result. Abandoning that method, not hastily, we introduced the tip and the first time it was withdrawn without any foreign body. After again consulting the letter from the roentgenologist more care was exercised in directing the tip to where the foreign body was located by the x-ray diagram and a piece of steel was removed with the tip.

May 20, 1919, a young man came into the office with the right eye cut in the lower quadrant, across the limbus one-quarter inch in length. Vision was 5/200. For some reason it was not possible to get a roentgenological examination. The Victor magnet was applied to the wound and a piece of steel was extracted about the shape and dimensions of the lead of an ordinary lead pencil 1/16 inch long. (The record states that the steel was extracted through the original wound but does not mention if that wound was enlarged.) Two days later the lens was cloudy and there was no fundus reflex. Vision was light perception. Two days later we had an x-ray examination that localized a foreign body in the posterior of the eye, which the introduction of the magnet tip was not sufficient to remove. On May 26, six days after the injury, I removed the eye and found the foreign body embedded in the sclera, where it was located by the roentgenologist, but so securely that it was removed by strong forceps with great difficulty. After the first day following the injury pain was constant and at the time of enucleation it had become almost unbearable. The eye showed the classical signs of infection and when a section was made it was evident it could not have been saved.

You will note that an x-ray examination of the eye could not be made at once, also that the examination was not made until four days after the injury. The removal of the foreign body also removed the idea that a picture was necessary. The probability of another foreign body in the eye would not have occurred to most of us. The lesson to be learned from this case is not the history of the case, the position of the patient, or the route of removal, but the necessity of a roentgenogram.

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DISCUSSION

Dr. William S. Manning, Jacksonville, Fla.—Unquestionably there are instances in which a man may have been misled by the history of the case, but I do not know of any department of medicine or surgery in which at times one may not be misled by history. It seems to me it is especially important in case of a foreign body in the eye, in the first place, because you must know of the possibility of infection.

In my experience brass, copper and cast iron have been the things that have given the most trouble. A wound with steel is nearly always clean, because it is usually a shaving off a grinding machine and the steel is more or less hot. But brass and copper and cast iron are dirty and invariably give trouble through infection.

The question of anterior or posterior route, I suppose will never be decided. Personally, I prefer the posterior.

Localization depends a great deal on the accuracy of the x-ray. I do not depend upon my own reading, as I do not see enough of them. And the man who makes the plates, unless you have a good one, is more likely to mislead than help you.

Dr. Clyde A. Clapp, Baltimore, Md.—The history of the injury should certainly not be disregarded, although occasionally it is misleading. Not only is it of value to get the ordinary history, but also in which direction the head was turned at the time of injury, and the character of the two substances being struck which produced the flying particle, since frequently one is magnetic and the other non-magnetic. If possible one should examine the tools to judge the size and character of the foreign body.

If the foreign body can be seen externally by the use of oblique illumination or the ophthalmoscope, it is not necessary to have the x-ray picture. The picture is confirmatory and of value, although if the foreign body is visible and this finding is not confirmed by x-ray, the x-ray is to be disregarded. I recall three cases that were reported negative when a metallic foreign body was present: two of the cases being very small, while the third was of considerable size.

While localization is absolutely essential for the old cases, and also the small penetrating foreign bodies, it is not so essential in the case which presents itself a few hours after injury, especially in the presence of a large, gaping wound. In this class of cases it is much safer immediately to apply the magnet and if possible extract the foreign body at the point of entrance. The sooner the removal is accomplished the better the prognosis. It must also be remembered that the localization is not infallible. Occasionally a foreign body localized in the eye is found in the orbit, and vice versa. All cases with a history of being struck in the eye without visible evidence of a foreign body, which is followed by complaint, should be x-rayed.

I wish to cite two cases illustrating the importance of such a procedure.

A young man engaged in engineering work was struck in the eye by a piece of steel. Several oculists informed him that his eye was normal, with no foreign body. Three years later he presented himself at our clinic with cataract and siderosis. The x-ray revealed a small metallic foreign body in the vitreous, which was easily extracted by a magnet with subsequent extraction of the cataract and good resulting vision. An x-ray at the time of injury should have been made.

A young man was seen a few hours after being struck in the right eye by a piece of steel. A small abrasion was found at the upper, outer limbus. The fundus was perfectly normal with vision of 20/200, but in one week the vision had improved to 20/30. The eye was watched for some time and there was no change, externally or ophthalmoscopically. A few months later he developed a brain abscess and died nine months following the injury. Autopsy showed a small needle-like piece of steel in the optic nerve back of the globe, from which the infection traveled to the brain. An x-ray would probably have cleared up the diagnosis.

I certainly prefer to have the patient in the prone position.

The relative value of anterior and posterior routes depends largely upon the character of the injury and the size of the foreign body. If the wound is corneal and the lens is already injured, then certainly I would choose the anterior. If the lens is uninjured and the foreign body of any size, then I recommend scleral incision and extraction posteriorly. Very frequently when drawn around the lens, zonular fibers are injured and lenticular opacities develop, if not immediately, at some later time. In other words, the route selected is determined by the surgical judgment of the operator, and not by any set rule.

Foreign bodies other than iron and steel are rarely seen in our clinic. Copper injuries have, however, been disastrous. Coal is tolerated very kindly by the eye.

Dr. Robert Scott Lamb, Washington, D. C.—If a localizing apparatus is accessible we should always use it. Where it is inaccessible we must reason to determine the probable direction and amount of force exerted by the foreign body and the depth to which it may have penetrated.

Dr. Sweet finds that his magnet, when applied

to a scleral puncture opening between the external and inferior recti muscles, extracts magnetic bodies sometimes as long as six months after the injury, and always in recent injuries. I have used to great advantage the Hirshberg magnet, introduced into the vitreous at the point where the foreign body is located by the localizer. I believe there was little disturbance to the vitreous, as the vision became normal shortly after the operation of extraction.

I agree with Dr. Heggie as to the position of the patient. In some cases it is even advisable to have the pronate position, which favors the removal of the foreign body, especially if it be non-magnetic.

Glass and lead particles may be left in the eye, if they are not easily found, with the understanding that the eye must be removed at the first sign of irritation of the eye or of any irritation in the opposite eye.

Dr. Heggie's very good observation of the need of looking for another foreign body applies equally to foreign bodies under the eyelid or in the cornea.

Dr. S. B. Muncaster, Washington, D. C.—A young boy was recently brought into my office from the country with the history that while he was playing with a piece of copper wire a strand broke and struck him in the eye. I saw him the fifth day after and found the foreign body about 3 millimeters back of the sclera. An x-ray located it about 3 millimeters back of the margin of the cornea. Dr. Groover stated that it was a very fine piece. I thought if I cut through the sclera it would be impossible to find the fine particle. I performed an operation similar to the Elliott, cutting the cornea all along. As I dissected up the conjunctival membrane, when at the point where the particle went through the sclera I found that the conjunctival membrane adhered to the sclera, and on dissecting between the layers of the sclera I found the fine particle, which was not larger than one millimeter in length and about the size of a large eyelash. I used mercurochrome after getting the foreign body out, washed it out with a solution of boric acid, then put seven stitches in the sclera to hold it in place, and inside of a week the boy's eye was all right. The sight was not injured. The eye might have been lost by any other operation because the particle was so near the ciliary body and was embedded in the sclera.

Dr. J. A. White, Richmond, Va.—Most of the literature of foreign body removal has dealt with bodies that passed into the eyeball. I have had two experiences with foreign bodies buried so deeply in the cornea that in attempting to remove them I pushed them into the anterior chamber and had to open the eye.

When I first began to use the magnet I found that by the anterior route I could get the foreign body in most cases, but I sometimes caused more damage with the magnet than the foreign body had done in entering the eye. Now when a foreign body is in the vitreous I invariably open the sclera and take it out that way, after x-ray localization, making the sclerotomy as near the foreign body as possible.

Removal should not be attempted under general anesthesia. It should be under local for the reason that you get a sensation of pulling that the patient can describe.

Sometimes a foreign body in the vitreous does not have to come out. Two years ago a man was sent to me with a minute piece of steel in the eye which had passed through the cornea, the iris, the edge of the lens, and lodged in the center of the vitreous. It was localized by an expert radiologist. There was no irritation of the eye and the vision was 20/20. To examine the eye carefully I put a drop of ¼ per cent scopolamin solution to dilate the pupil, with a peculiar result. I could easily see the foreign body and sent him to my friend, Dr. John Dunn, as a very unusual case. Dr. Dunn sent him to the Eye Infirmary, where he was stopping, but he disappeared, and I enlisted the services of the police, thinking that he was lost. He came in the next day, saying that after I put the drop in his eye he went to Dr. Dunn's, but had no recollection of leaving his office or of what he did until he awoke in a hotel the next morning. He had no recollection of what had happened for twenty-four hours, his mental aberration probably being due to the effect of the hyocin dropped into his eye.

Dr. J. A. Stucky, Lexington, Ky.—I would like to ask the essayist whether he knows any better method than we now have for locating a piece of glass in the eye. With fluoroscin and mercurochrome, if there is an abrasion, of course we can outline that and make a stain; but sometimes a piece of glass gets under the conjunctiva several millimeters from the abrasion. How are we to find it?

Dr. Hiram Woods, Baltimore, Md.—One night I saw a gentleman in severe pain, with the following condition: the cornea had been dug at four times during the day, with the supposed removal of four foreign bodies. There was a hole in the cornea with Descemet's membrane protruding, and just underneath a pigmentel spot at the extreme periphery of the iris. This mistaken diagnosis is a possibility with peripherally located foreign bodies.

An easily overlooked place where foreign bodies may lodge is the canaliculus. I have seen several cases where there was a lash in this little canal. A case with copper in the eye is absolutely hopeless. I have never seen one that did not finally come to enucleation.

The x-ray is not infallible. I saw a man with

a piece of steel located just external to the outer periphery of the lens. When the magnet was applied there was a little gush of vitreous and a small bit of steel came with it. The eye did not get well. After several weeks it was red and painful. An x-ray made by the same roentgenologist showed another foreign body. In other words, there were originally two foreign bodies and the x-ray picture showed but one. Eventually enucleation was done.

I am watching a boy now who had traumatic cataract due to a bit of shot which penetrated the eye. At first three shot were located in the vitreous. The eye has gone on for two years without irritation. Two subsequent x-ray pictures have shown that one shot has disappeared and one of the others is outside the globe.

In the choice between anterior and posterior routes, a great deal depends upon one's own experience. Gentleness of manipulation is absolutely necessary. A boy had 20/30 vision with slightly cloudy media and a small foreign speck visible in the lower and outer portion of the vitreous chamber. To have drawn this around to the anterior chamber would have been difficult and dangerous. A posterior incision was made and the tip of the magnet put to the lips of the scleral incision, not into the chamber. The foreign body came out with complete restoration of sight.

I removed a foreign body which I could not see by the anterior route. It came around to the edge of the lens and caught behind the iris. Every time the magnet was applied the iris bulged forward. I did a small peripheral iridectomy and it came out easily, restoring 20/70 vision. Unless the foreign body is visible and accessible to a scleral puncture, the anterior route is, on the whole, the one of preference.

I am afraid of scopolamin. I feared that by it I had killed two girls who came to my office a few years ago for refraction correction. I never saw two people collapse so completely as they with one drop of a 1 per cent solution of scopolamin.

Dr. W. L. Howard, Memphis, Tenn.—The result of removing a foreign body depends upon the localizing point.

A point that the Doctor did not mention is the after-treatment and the damage the foreign body has done in puncturing. If you have a large, penetrating wound of the cornea through the iris, due to foreign body and its extraction, I have found it very serviceable, after being sure there is no infection and no foreign body left, to do a conjunctival flap operation and cover the wound through which the foreign body entered.

During the last year I have treated five or six this way with satisfactory results.

Dr. W. Herbert Adams, Jacksonville, Fla.—I want to call attention to one of the most important points in the diagnosis of foreign body, that is, lowered tension of the eye. There is always loss of tension. You must be very careful, if you do not find the foreign body externally, that there is not an intra-ocular foreign body.

I have had one or two experiences where the x-ray showed two foreign bodies when there was only one, due to a shifting of the machine when the picture was taken.

Dr. Heggie (closing).—The only method that I know for finding a piece of glass in the eye is inspection by intense light, and good reflection.

I agree with Dr. White that we should always use common sense, judgment—and in addition the x-ray.

Dr. Bruns thinks the patient should never be under a general anesthetic. Local anesthesia is preferable, but there are some patients with whom a general anesthetic is a necessity.

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EDITORIAL DEPARTMENT

SOUTHERN MEDICAL ASSOCIATION
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SICKLE CELL ANEMIA

The only apparent disease entity which has been found in the negro race but so far not in the white, sickle cell anemia, was described first in 1910.[1] From that time till 1923 only three additional cases were reported in the literature, though in the last year and a half the total has been swelled to eighty. According to Sydenstricker[2] and Huck,[3] it is familial and hereditary. It was found in one-fourth of 1 per cent of negroes examined. The diagnostic sign is the finding of peculiar "sickle"-shaped red blood cells in fresh blood smears, or in smears which have been sealed with petrolatum and allowed to stand eighteen to twenty-four hours.

It occurs in two phases, the latent in which the bizarre shaped red cells may be found in the sealed smears only, and the active in which "sickling" may be observed in the fresh stained smear, and is accompanied by a very definite syndrome. In the active cases, dyspnea, weakness, muscle and joint pain, greenish-yellow sclerae, abdominal crises with nausea and vomiting, general glandular enlargement, enlarged liver, a heart characteristic of anemia, a urine of low fixed specific gravity containing urobilin and frequently albumin and casts, and leg ulcers or scars, are usual findings. Achylia is present. The red cells are reduced to the neighborhood of two million and there is a marked leucocytosis. The resistance of the erythrocytes to hypotonic salt solution may be slightly increased. The red cells have been shown to sickle even in normal blood serum *in vitro*, and when transfused into a normal subject to retain the property of sickling for a time at least, though the number after transfusion slowly decreased while the patient was under observation.[4]

In the latent form which is the more common the characteristic symptoms are greenish-yellow eyeballs, general glandular enlargement, complaints of "growing pains," attacks of epigastric or left hypochondriac pain, periods of dyspnea, perhaps poor general condition and lowered resistance. The peculiar erythrocytes will be found in the sealed fresh smears. Frequently there is no anemia or leucocytosis. Sydenstricker considers it primarily a defect of the spleen and blood forming organs, which results in the formation of erythrocytes liable to hemolysis and phagocytosis.

Further elucidation of the problems of the physiology and therapeusis of sickle cell anemia will depend largely upon Southern effort. Light thrown upon it will add information upon the diseases of the blood in general and may have considerable influence upon the mortality of the

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negro race. The practitioner in general, the physician in charge of a large negro clinic, and the public health official who may examine negro school children, should be on the lookout for any manifestations of this disease.

ETIOLOGY OF CHOREA

Epidemic chorea, or the "dancing mania," was one of the earliest medieval pandemics. It acquired the name St. Vitus dance from the processions of dancing patients in the Strassbourg epidemic of 1418 who proceeded to the chapel of St. Vitus for treatment.[1]

In view of the long existing uncertainty as to the etiology of chorea, any experimental work in its production is attentively examined. According to Holt,[2] in 1911, it is a functional nervous disease which bears an important relation to "rheumatism." It has been known to occur epidemiologically in institutions, but the role of bacteria in its production he regarded as still undecided.

According to Dr. A. H. Byfield,[3] a direct relationship between chorea and focal infection is not apparent. Some improvement has been reported after tonsillectomy, he states, but the probable cerebral involvements of the disease cause one to expect little improvement.

Dr. E. C. Rosenow[4] has inoculated dogs with a streptococcus isolated from swabbings of the tonsils and nasopharynx of cases of human chorea and produced in the animals symptoms resembling chorea. The power to produce chorea in animals was maintained through many culture generations, as high as the twelfth, by making the subcultures from four to six times a day, and through three animal passages, but was lost rapidly on aerobic cultivation on blood agar plates. He also reports the production of chorea symptoms and tissue pathology after the injection of the tooth canals of dogs with cultures from cases of chorea. At necropsy, the tendency of the "chorea strains" to involve heart valves, joints and muscles, as well as brain, was more marked than that of strains of streptococci from other sources.

Cases of chorea are usually treated by the elimination of focal infection, though marked success immediately following this is not regularly observed. This may be due, as was suggested, to the tissue damage which has already taken place. Treatment along this line, however, still offers the best opportunity for improvement of the condition. The work of Rosenow serves to demonstrate further the possibilities of systemic infection from infected foci.

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4. Rosenow, E. C.: Experimental Observations on the Etiology of Chorea. Am. J. Dis. Children, xxvi, p. 223, July-December, 1923.

PREVENTION OF DIARRHEA IN INFANCY

Deaths from diarrhea in infancy have been very notably reduced in the last twenty-five years, as is shown in the Symposium on Diarrhea in this issue of the JOURNAL, but the results have been due rather more to preventive work and the dissemination of the general principles of child hygiene than to the development of new lines of treatment. Success has been reported in the treatment of bacillary dysentery with the bacteriophage.[1]

1. Spence, Ralph C., and McKinley, Earl B.: The Therapeutic Value of the Bacteriophage in Treatment of Bacillary Dysentery. Sou. Med. Jr., Vol. xvii, No. 8, August 1924, p. 563.

As a preventive of diarrhea, breast feeding during a large part of the first year of life is the most important measure. In artificial feeding, the freshness of the milk is to be considered above all things, except the prevention of bacterial contamination. The importance of boiling sweet milk is now rather generally emphasized. Very gratifying results have been reported in lowering the incidence and mortality from dysentery through the use of lactic acid milk and corn syrup.[2] The use of excessive carbohydrate, particularly sugar, and irregularity of meal and rest hours are tendencies to be particularly avoided in infancy. But substances other than food go into the runabout child's mouth and the food supply is not to be accused if he eats manure or drinks water from mud puddles, as he frequently likes to do.

The physician in prescribing the infant's diet has to deal with the danger of violent illness or death from infecting organisms on the one hand and that of diminished resistance and slow endocrine or other organic change from a slight vitamin lack or imbalance on the other.

The prompt reporting of diarrheas to health authorities that they may make an effort to arrive at the source of infection is not usually done, although it would be highly desirable. Prevention of the occurrence of diarrhea anywhere is an ideal always to be kept in mind, to be attained largely through patient instruction of the laity. The profession is to be congratulated that it has some practical means which may be used to eliminate this widespread scourge, and that these means are being applied a little more widely every year.

2. Marriott, McKim: The Teaching of Infant Feeding. Sou. Med. Jr., Vol. xv, No. 7, July 1922, p. 530.

Our Convention City

SANDY SEES NEW ORLEANS

II.

SANITATION

Forty million gallons of water. Boy, page Mr. Volstead! Forty million gallons of drinking water! What a theme for prohibitionists — pure, clear, sparkling water, drawn and filtered from the muddy Mississippi every day—filtered, chemically and microscopically tested, according to U. S. standards by the most modern and gigantic filtering plant of its kind, a plant devised and constructed to separate the mud of the Mississippi Valley from the water supply of New Orleans.

Imagine large concrete reservoirs covering four city squares into which this liquid mud is drawn for the purpose of sedimentation after the admixture of an infinitesimal amount of lime and iron. Here it is allowed to stand until sedimentation has cleared it. The process of sedimentation completed, the water is passed through enormous filters formed from a three-foot layer of Horn Island sand, thence passed on to the pure water reservoirs, which cover two city squares. With even this cursory conception of this plant, you may readily see what its construction has meant. Its vastness, its systematic uniqueness, its perfection of functioning easily repays one for the time spent in visiting it.

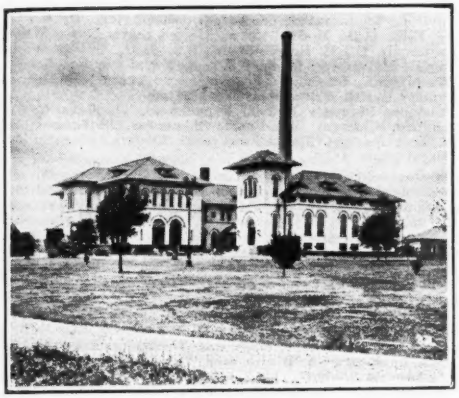
This plant is the direct result of a great city's effort in advancement. Constructed synchronously with the sewage and drainage system of New Orleans, it is now an integral part of this vast trio. The sanitary value of this trio is nowhere more manifest than in the enormous decline of typhoid fever, the practical disappearance of malaria as a local product, the cutting down to a minimum of summer intestinal disturbances, and the total elimination of the yellow fever, which periodically invaded this city from the tropics.

Visit this water plant and see what millions of dollars supported by an indomitable will and an endless enthusiasm for advancement have accomplished. It is only one of the many monuments to progress and push to be found in this very modern and up-to-date city, within whose confines a few city squares are still reserved as an evidence of the romance of the past, the Vieux Carrè.

Just as you will find hidden in some treasured and guarded spot among the effects of every great man, either a faded rose, a crumpled lace kerchief, or a fan once swayed by a hand whose touch thrilled, and the memory of which is still verdant, so you will find this spot of romance today in New Orleans. It is an integral part

of her, but as in the instance of every great entity, it is ever present and never dominating. The presence of romance we feel as a valuable influence, but never as an activating motive. Romance would never have built the filtration plant and its concomitant sewage and water system to clear the city of insanitary conditions. Nor would romance rat-proof the city from its docks to its stables to eliminate bubonic plague. The very name "rat-proof" is a direct antithesis to romance.

Sanitation in New Orleans is a perpetual program. Drainage has lowered the sub-surface water level, clearing the marsh lands around. The abolishment of the cisterns, which were receptacles to catch and hold rain water for drinking and household purposes, has practically done away with mosquito breeding places, thus accounting for the eradication of yellow fever and the gradual disappearance of malaria.



Filtration Plant

The old French market, where in the days of romance the city's meat supply was open to the inspection of both the city's populace and the city's flies, is now open only to the former. An arbitrary health board has eliminated the latter in the name of sanitation. Screens, fans, flowing water, refrigeration have in no way curtailed its utility as a vantage point of interest to visitors, but have enhanced its economic potentialities. Here again romance has bowed to the pressure of energy and progress.

Contrast with these remarkable and truly modern evidences of sanitation, the conditions prevailing in the early history of New Orleans, and realize thereby more fully the wonderful victories which have been won in order to achieve the present status. In the days before the use of cisterns water was brought from the river in large earthen jars and sedimented by peach kernels or minute quantities of alum. This water was used for drinking purposes and for the washing of linens, thereby preventing discoloring by the yellow mud of the river. A little later wooden cisterns were constructed. The water was collected from the housetops and conveyed by copper and tin gutters to the cisterns, where it was stored for use. The first public water pipes were cypress logs hollowed out. A bit of this pipe is still to be seen on display at the Cabildo.

In the earliest days sewage was dropped into ordinary holes. Considering the high level of sub-surface water, resulting conditions may be imagined. Soon these cesspools were lined with brick, but even then seepage was great. Rain overflow and excess household fluid drained into trenches dug along the banquettes. These led to overflow which eventually found their way into the lake.

Owing to the sub-surface water the territory surrounding the Vieux Carrè was constantly marshy, making wonderful breeding places for mosquitoes. Overflow from the Mississippi and at times Lake Ponchatrain added to the excess supply of water, so that the marsh surrounding the city was kept constantly moist. Wells were dug extensively to compensate for lack of water caused by drought and not infrequently these were used for drinking purposes. Seepage being the prime source of supply in these wells, morbidity in intestinal conditions was proportionately great.

But today! The filtration plant is the symbol of the city's sanitation. Around it, ramifying into it, intermingling with it in every direction, is every sanitary activity of New Orleans. It is the escutcheon of today as surely as the old wooden, hand-bored pipes, marvel of the artisan's craft, were indicative of former days.

Visit the filtration plant. It is, however, not to be seen through narrowed lids, to gain a hazy perspective, but is to be inspected minutely, section by section, both as an object of interest and as an example of remarkable sanitary engineering. It is one of the points in New Orleans which stands out as a place of interest, education, economy and sanitation, as well as an evidence of what New Orleans is doing in our everyday work-a-day world.

SANDY.

(To be continued)

Of Current Interest

THE PRESIDENT'S PHYSICIAN*

Dr. James F. Coupal, Major, Medical Corps, U. S. Army, has been appointed Physician to the President, Mr. Coolidge, succeeding Dr. Sawyer, resigned, who was the appointee of the late Mr. Harding. Major Coupal is here shown at work in his laboratory at the Army Medical Museum.

Major Coupal is Curator of the Army Medical Museum and President of the Association of International Museums. He is a deep student of bacteriology and pathology, this being his chosen line of work. He was born in Springfield, Massachusetts, January 26, 1884, and was graduated in medicine in 1909. In 1911, he started his Army career by entering the Medical Corps of the Massachusetts National Guard. In 1919, he was a Major in the Medical Corps of the National Army; and on July 1, 1920, he was appointed to the same rank in the Regular Army.

Many of those who attended the Southern Medical Association meetings in Louisville in November, 1920, and in Washington last November will remember the interesting and helpful scientific exhibit by the Medical Department of the Army. Both of these were prepared by, and installed under the direction of, Major Coupal. Both were given awards by the Committee on Scientific Exhibits. Only those who have had the privilege of going through the Army Medical Museum can appreciate the splendid work which Major Coupal has done as Curator.

His many friends among the medical profession in the South will rejoice in the deserved honor which has come to him in being appointed Physician to the President of the United States.

*Photo by Henry Miller News Picture Service, Inc.

Book Reviews

The Medical Interpreter. A Quarterly Digest of Medicine and Surgery, Domestic and Foreign. Illustrated. Selected Practical Foreign Medical and Surgical Literature. Albert Allemann, A.B., M.D., Principal Assistant Librarian Surgeon General's Library, Army Medical Museum, Co-Editor Index Medicus, Editor-in-Chief, Washington, D. C. Recent Practical Advances and Attitudes in Medicine and Surgery, Major James F. Coupal, Medical Corps, U. S. Army; Curator, Army Medical Museum, Washington, D. C.; Professor of Pathology, Army Medical School; Professor of Dental Pathology, Army Dental School; Pathologist, Columbia Hospital for Women, Washington, D. C. The Bureau of Medicine and Surgery, J. W. Schereschewsky, Assistant Surgeon General, in charge, Division of Scientific Research, Washington, D. C.; J. W. Ellis, M.D., Medical Corps, United States Navy, Washington, D. C.; E. R. Whitmore, B.S., M.D., George Washington University, Medical School, Naval Medical School, Washington, D. C.; C. F. Bolduan in charge, Section of Public Health Education, Washington, D. C.; Wm. A. Brennan, Formerly Medical Department, The John Crerar Library, Chicago, Ill.; E. M. Salmonsen, Department of Medical Science, The John Crerar Library, Chicago, Ill. Washington, D. C., 1924.

In this volume, which has been dedicated to the American Medical Association and to the Southern Medical Association, the papers for abstraction have been very carefully selected. It is important for the American physician to become acquainted with foreign work and methods, which in the presence of the voluminous and ever-increasing American medical literature it is a difficult task. The book is in excellent print, is well edited, and is worthy of a hearty welcome from the profession.

A Text-book of Pharmacology and Therapeutics Or the Action of Drugs in Health and Disease. By Arthur R. Cushny, M.A., M.D., LL.D., F.R.S., Professor of Materia Medica and Pharmacology in the University of Edinburgh; Formerly Professor of Materia Medica and Therapeutics in the University of Michigan, and later in the University of London. Eighth edition, thoroughly revised. 707 pages. Illustrated, with 73 engravings. Philadelphia and New York: Lea & Febiger. Cloth, $6.00.

The discussion of cocain and the cocain substitutes is inclusive. The advances in cardiac therapy are recognized in dealing with digitalis and the cinchona bases. Vitamins A, B and C have not been omitted. Very brief mention is made of the fact that carbon tetrachlorid has been used successfully as an anthelmintic; only a little over a page is devoted to the greatest therapeutic discovery of the age, insulin; and chaulmoogra oil, which has accomplished so much in leprosy, is dismissed in three or four lines.

Considering the lengthy intervals between editions, these shortcomings will be regretted by the medical profession, which has very eagerly awaited this new edition.

Cushny and his book are authoritative. His views are accepted as the last word in pharmacology. Any criticism that is offered is based upon the brevity of his statements rather than upon any inaccuracy in his remarks. No practitioner of any branch of medicine can afford not to own the book.

How Our Bodies Are Made. By R. M. Wilson, M.B., Ch.B. With 245 pages. Illustrated. London: Henry Frowde and Hodder & Stoughton, 1924.

This contains a great deal of information intended particularly for the young boy. Matters pertaining to sex are not emphasized. It is a very elementary treatise on physiology and hygiene.

Blood Pressure: Cause, Effect and Remedy. By Lewellys F. Barker, M.D., and Norman B. Cole, M.D. With 153 pages. New York and London: D. Appleton and Company, 1924. Cloth, $1.25.

The intelligent physician is more and more taking his patient into his confidence in treating him, realizing that the patient's understanding and co-operation are the first essentials for any kind of successful therapy. Dr. Barker and Dr. Cole's long experience not only in the fundamentals of medicine but in dealing with laymen of all classes make them particularly suitable for selecting the material for a book of this kind. The internist or practitioner could not do better than recommend "Blood Pressure" to his hypertension cases, or to any laymen who wish to inform themselves on the subject.

A Practical Handbook of Diseases of the Ear. By William Milligan, M.D., Aurist and Laryngologist to the Royal Infirmary, Manchester; Consulting Surgeon to the Manchester Hospital; External Examiner University of London; Lecturer upon diseases of the Throat, Nose and Ear to the Victoria University of Manchester; and Wyatt Wingrave, M.D., Pathologist (Lately Physician) to the Central Throat and Ear Hospital, London. New York: William Wood & Co. Cloth, $3.50 net.

This small monograph, intended primarily for senior students, will prove a most valuable reference handbook for the general practitioner as well. It is well written, covers the ground very thoroughly and is beautifully illustrated.

Gynecology. By William P. Graves, M.D., Professor of Gynecology at Harvard Medical School. Third edition, thoroughly revised. Octavo volume of 936 pages, with 388 half-tone and pen engravings and 146 microscopic drawings, 103 of the illustrations in colors. Philadelphia and London: W. B. Saunders Co., 1923. Cloth, $9.00, net.

The volume is divided into three parts: (1) dealing with the physiology of the pelvic organs and the relationship of gynecology to the whole organism; (2) descriptions of the diseases which are essentially gynecologic; and (3) the technic of gynecologic surgery.

A great variety of operations are described with splendid illustrations. Simple operations upon the kidney are included in this edition. The technic and value of radium in gynecologic conditions are discussed. The use of the Percy cautery is described. The insufflation test for the determination of tubal patency is briefly considered.

The work covers the field of gynecology very adequately and is rendered still more useful by the remarkably clear illustrations, which were executed by the author himself. As a textbook for students and a reference for the practitioner, Graves' "Gynecology" continues to rank high.

The Medical Clinics of North America (Issued serially, one number every other month). Volume VII, Number VI, May, 1924. By Internists of McGill University, Montreal, Canada. Octavo of 305 pages with 49 illustrations and Complete Index to Volume VII. Per clinic year (July, 1923, to May, 1924.) Philadelphia and London: W. B. Saunders Co. Paper, $12.00 net. Cloth, $16.00 net.

This publication has always been looked forward to by its subscribers with expectation, and the high standard that has been maintained has always come up to the expectations.

The present volume is of interest not only in the selection of the clinics but the fact that it shows the high class work that is being done in Canada. Throughout the volume there is no clinic that is not worthy of careful study, and special mention would only be given to individual clinics by those who were interested in a particular phase of medicine.

The Operating Room. Instructions for Nurses and Assistants. By the Staff of St. Mary's Hospital, Rochester, Minn. (The Mayo Clinic.) 12mo. of 165 pages, with 144 illustrations. Philadelphia and London: W. B. Saunders Co., 1924. Cloth, $1.75, net.

This contains accurate illustrations of the arrangement of the operating room for most operations, the preparation of the patient, and lists and photographs of the instruments, with descriptions of the sutures, etc., required for each operation. How to operate the autoclave, arrange trays for dressings, etc., are included. It will prove a valuable textbook and reference manual for nurses in any hospital.

Textbook of Psychiatry. By Prof. Dr. Eugene Bleuler, Director of the Psychiatric Clinic, Zurich. Authorized English Edition, by A. A. Brill, Ph.B., M.D., Former Assistant Physician of the Central Islip State Hospital and Assistenzarst of the Clinic of Psychiatry, Zurich. Lecturer on Psychoanalysis and Abnormal Psychology, New York University. With 635 pages, illustrated. New York: The Macmillan Company, 1924.

Although the translator's preface states that Professor Bleuler was the first noted psychiatrist who recognized the great value of Freud's discoveries, this book does not devote many pages to a detailed description of sexual abnormalities and an analysis of dreams in terms of them. It contains classifications, descriptions, and suggestions for treatment of the various mental diseases. Photomicrographs of the brain cortex in different mental conditions are particularly worthy of note. The author lays considerable emphasis upon the comparison of the handwritings of paretics, alcoholics, seniles, schizophrenics, hebephrenics, etc., and shows illustrations of all these.

The Circulatory Disturbances of the Extremities, Including Gangrene, Vasomotor and Trophic Disorders. By Leo Buerger, M.A., M.D., New York City. Octavo volume of 628 pages, with 188 illustrations. Philadelphia and London: W. B. Saunders Co., 1924. Cloth, $8.50, net.

This work contains a large mass of valuable material, written in a style which is occasionally wordy and always highly technical. Very good photomicrographs show the cellular differences of venules, arterioles, capillaries, etc. The illustrations, although not numerous, are worth while. The author gives extensively the theories of various foreign writers who have contributed to the subjects of normal circulation of the extremities, thrombosis, the vegetative nervous system, and the vasomotor neuroses, etc.

The peripheral circulation, gangrene, thrombo-angiitis obliterans, and arteriosclerosis, are thoroughly treated, as well as the less frequent affections of the extremities.

This is probably the best and most complete American monograph that has appeared on the subject.

Domiciliary Treatment of Pulmonary Tuberculosis. By F. Rufenacht Walters, M.D., B.S., M.R.C.P., Lond., F.R.C.S., Eng. Medical Director Crooksbury Sanatorium; Late Joint Tuberculosis Officer to the Surrey County Council; Physician to the Mount Vernon Hospital for Consumption, Etc. Second Edition, 288 pages. New York: Wm. Wood & Co. Cloth, $4.00.

Certain sections in the book could be read with profit by any physician, as those on the predisposing causes, and the question of determining home or sanitorium treatment for the patient.

The section on open air treatment is also well expressed but the questions as to treatment of definite conditions with drugs is not in accordance with either the American or European modern standards. There are too many proprietary preparations mentioned throughout the text.

The sections on the use of tuberculin lack clarity, and the author gives too many methods from which the physician must choose to make the book of real value for those for whom it was primarily written.

Public Health Nursing. By Mary Sewall Gardner, R.N., A.M.; Director Providence District Nursing Association; Honorary President, National Organization for Public Health Nursing. Second edition, completely revised. 432 pages. New York: The Macmillan Co., 1924.

It is a pleasure for the reviewer to have brought to his consideration a book like that of Miss Gardner's.

The subject is divided into six parts with an appendix: The development of public health nursing; public health nursing under private auspices; public health nursing under public auspices; the nursing group; special branches of public health nursing; records and statistics. The appendix is devoted to a chronological consideration of development of public health nursing, the National Health Organization for Public Health Nursing; the Red Cross Public Health Nursing Service; the National Health Council, and the conclusions of the Rockefeller committee for the study of nursing education.

To those interested in placing the nurses on a higher standard educationally, a book like the present is an inspiration.

Two facts stand out prominently throughout the book. The author is fully familiar with her subject and has a happy faculty for presenting it.

Diseases of the Chest and the Principles of Physical Diagnosis. By George W. Norris, M.D., Professor of Clinical Medicine in the University of Pennsylvania, and Henry R. M. Landis, M.D., Director of the Clinical and Sociological Departments of the Henry Phipps Institute of the University of Pennsylvania, with a chapter on the Electrocardiograph in Heart Disease, by Edward Krumbhaar, Ph.D., M.D., Director of Laboratories of the Philadelphia General Hospital. Third Edition, Revised. 907 pages with 433 illustrations. Philadelphia and London: W. B. Saunders Co., 1924. Cloth, $9.50 net.

The fact that there have been three editions of this book since 1917 speaks for its deserved popularity. The subject is presented in a full, yet lucid manner. It can be used by the student in the latter years of medicine with advantage as well as by the physician who wishes a full and complete reference book on this subject.

The present edition shows a careful revision and many sections have been rewritten.

Psycho-Analysis Analyzed. By P. McBride, M.D., F.R.C.P.E., F.R.S.E. With introduction by Sir H. Bryan Donkin, M.D. (Oxon.), F.R.C.P. 142 pages. London: William Heinemann Medical Books, Ltd. Cloth 3/6, net.

The author takes a stand against this method of psychotherapy. He presents his case with fairness and there is much to commend the book. He has tried to present his facts and deductions in a conservative manner and in the main has succeeded.

The introduction by Donkin is too long, covering 18 pages, and lacks at times the moderation characterizing McBride's presentation of the subject. A fact of great importance that he brings out is the danger of the universal application of such a method in neurotic individuals.

A Woman's Quest. The Life of Marie E. Zakrzewska, M.D. Edited by Agnes C. Vietor, M.D., F.A.C.S., Formerly Instructor in Physical Diagnosis and Surgery, Woman's Medical College of the New York Infirmary; Later Assistant Surgeon, New England Hospital for Women and Children, Boston. Illustrated. New York and London: D. Appleton and Company, 1924. Cloth, $3.00.

This is an unusual history of the struggle of a woman who studied medicine in America 70 years ago, at a time when in Philadelphia no clergyman would offer prayers at the Female Medical College, and physicians who taught in it were expelled from the County Medical Society. It gives a vivid picture of the times while portraying the life and noble character of one of the trail-blazers in medicine.

Clinical Aspects of the Electrocardiogram. A Manual for Physicians and Students. By Harold E. B. Pardee, M.D.; Associate in Medicine, Cornell University Medical School; Assistant Attending Physician, New York Hospital; Consulting Cardiologist, Lying-In Hospital and Woman's Hospital, New York City. 222 pages with 56 illustrations. New York: Paul B. Hoeber, Inc. Cloth, $4.00 net.

Dr. Pardee has had a basic training and a wide clinical experience in electrocardiography.

The subject is presented in a clear and logical manner, the first chapter taking up definitions and explanations of what the deflections are caused by in the electrocardiogram.

Chapter 2 considers a normal electrocardiogram and its variations. Further chapters are on the changes due to hypertrophy of the auricles and ventricles; changes due to myocardial abnormality; the clinical significance of abnormal waves; disturbances in rate and rhythm; clinical aspects of abnormal rate and rhythm; clinical application of the electrocardiogram; the theory of the electrocardiogram, and a description of the electrocardiogram. This is followed by an appendix which contains Eintoven's Tables to determine the Angle Alpha, and manifest potential. A concise but well selected bibliography is added.

Throughout the book the author has shown moderation in his deductions, and has stressed the fact that this method is simply one of the procedures in arriving at a diagnosis and not to be used to take the place of a full clinical study of his patient. On the section dealing with myocardial abnormalities the author is clear but at times draws deductions that are more complete than some others might consider justified by the curves.

The section on description and operation of the electrocardiogram is very clear and will prove of value to anyone interested in this subject. The book is well gotten up and has few typographical errors.

Southern Medical News

ALABAMA

At the recent conference of State and Provincial Health Officers of North America, held in Lansing, Mich., Dr. S. W. Welch, State Health Officer, Montgomery, was named a member of the Executive Committee.

Deaths

Dr. Orson Lucius Crampton, Mobile, aged 81, died May 25.

Dr. William Henry Ludewig, Foley, aged 71, died May 18 from angina pectoris.

Dr. John B. Harvey, Robertsdale, aged 67, died suddenly May 25 from heart disease.

ARKANSAS

The Missouri Pacific Railroad will erect a $750,000 hospital at Little Rock. The hospital will accommodate 120 patients and will be ready for occupancy October 1.

The Trinity Hospital, Little Rock, will be completed some time soon. The hospital will contain fifty beds.

Dr. Morgan Smith, Little Rock, will again become Dean of the University of Arkansas School of Medicine. He resigned from this position last fall.

The Baptist Hospital, Little Rock, being built at a cost of $500,000, will be ready for occupancy soon.

Dr. L. J. Kosminsky, Texarkana, has been elected President of the Arkansas Elks' Association.

The sixty-bed Children's Hospital, Little Rock, which will cost $150,000, will be completed in a few months.

Deaths

Dr. William H. Cannon, Saratoga, aged 70, died May 19 at a sanatorium in Texarkana.

Dr. Flavius J. Marberry, Little Rock, aged 65, died May 31.

Dr. William Blakemore Hughes, Little Rock, aged 64, died May 29.

Dr. Daniel Arthur Gray, Hot Springs, aged 77, died May 25 at a local hospital.

Dr. Carlos C. English, Booneville, aged 45, died April 12 at St. Joseph's Hospital, Kansas City, Kan., from heart disease.

DISTRICT OF COLUMBIA

The Wapiya, which comprises the medical members of the University Club of Washington, recently issued the first number of a bulletin entitled the "Tom Tom."

Dr. George M. Kober, Washington, was elected Secretary of the National Tuberculosis Association at its meeting held in Atlanta, Georgia, in May.

Dr. Ramsay Spillman, Washington, and Miss Margaret Eleanore Kimmel, Fort Hamilton, N. Y., were married May 12.

Dr. James M. Fadeley, Washington, and Miss Marian Parker, Berryville, Va., were married in New York May 2.

Dr. Theodore W. Kemmerer, Washington, and Miss Mabel Clare Williams, Iowa City, were married June 4.

Deaths

Dr. Hugh Clarence Duffey, Washington, aged 54, died May 31.

FLORIDA

The Miami City Hospital, Miami, will be known in future as the James M. Jackson Memorial Hospital.

The orthopedic service of the State Board of Health, after having been closed for two years, has been reopened at Jacksonville under the supervision of Dr. Frank L. Fort, Shreveport, La. All treatment will be free for any indigent crippled child under 16 years of age. The service was created by special act of the Legislature in 1911 and was operated until 1922, when it was closed because of the failure of the Legislature to provide funds for its maintenance. It will now be a permanent and integral working unit of the State Board of Health. White patients who need hospital treatment will be sent to St. Luke's Hospital, and colored patients to Brewster's Hospital.

(Continud on page 34)

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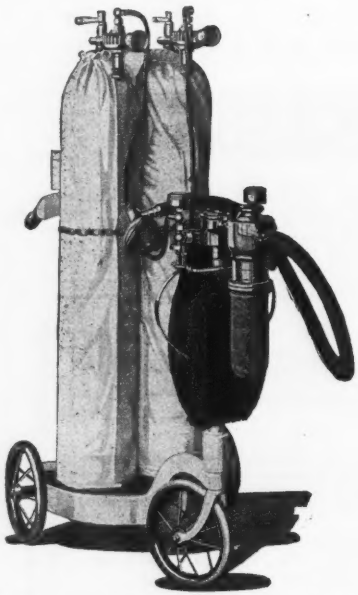

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(Continued from page 638)

Dr. Ralph E. Barnes, of the Florida Public Health Association, was elected President of the Southern Tuberculosis Association at its meeting held in Atlanta, Georgia, in May.

Deaths

Dr. Archie Rosco Parrott, Miami, aged 40, died suddenly in May.

Dr. Jesse Winlow Taft, Mount Dora, aged 52, died May 24.

GEORGIA

The Southern Tuberculosis Association met in Atlanta in May. Dr. Ralph E. Barnes, of the Florida Public Health Association, was elected President.

The National Tuberculosis Association also met in Atlanta in May. Dr. Charles J. Hatfield, Philadelphia, was elected President; Dr. George M. Kober, Washington, D. C., Secretary.

The Washington General Hospital, Washington, was recently completed at a cost of $25,000. It is being operated by the Wilkes County Medical Society. Miss Ethel Knight, formerly with the Athens General Hospital, Athens, has been appointed Superintendent.

The Woman's Auxiliary was organized during the meeting of the Georgia State Association held in Augusta. Mrs. James N. Brawner, Atlanta, was elected President; Mrs. G. T. Bernard, Augusta, First Vice-President; Mrs. Paul L. Holliday, Athens, Second Vice-President; Mrs. Allen H. Bunce, Atlanta, Secretary.

An old-fashioned barbecue was recently given in honor of Dr. Roger A. Mallory, who has practiced forty years in Concord. The entire 450 inhabitants of Concord attended the barbecue. Dr. Mallory was presented with a gold watch and charm.

Deaths

Dr. James Bozeman Baird, Atlanta, aged 75, died June 6.

Dr. Pope Barrow Crumbley, Leesburg, aged 41, died June 8 at the Phoebe Putney Memorial Hospital, Albany.

KENTUCKY

At the annual meeting of the Kentucky Tuberculosis Association, held recently, Dr. Jefferson L. Atkinson, Campbellsville, was elected First Vice-President, and Dr. James S. Lock, Barbourville, Executive Secretary.

The Third District Medical Society held the first meeting with the Warren County Medical Society on April 23. Dr. R. L. Woodard was elected President; Dr. W. A. Guthrie and Dr. C. C. Turner, Vice-Presidents; Dr. J. H. Blackburn, Secretary.

The Kentucky Public Health Association has elected Dr. Arthur T. McCormack, Louisville, Director.

A new department of Physiology and Pharmacology has been organized at the University of Louisville. Dr. Henry G. Barbour is Professor of Physiology and Pharmacology; Dr. William F. Hamilton, Assistant Professor of Physiology; Rheinhard Beutner, of the University of Leyden, Assistant Professor of Physiology and Pharmacology; Dr. Hulbert V. Noland, Instructor in Clinical Pharmacology.

A gift of $20,000 has been made to the University of Louisville Medical Department by the Carnegie Corporation. Plans are being perfected for raising an endowment fund. The added funds will be used largely to develop the Department of Pediatrics on an academic basis and to establish an academic teacher in that department.

Deaths

Dr. Jesse Adolphus Amon, Lancaster, aged 59, died May 19 from injuries received in an automobile accident.

Dr. Samuel B. Cheatham, Burkesville, aged 74, died March 3 from pneumonia.

Dr. Joseph K. Cissell, Loretto, aged 62, died June 4.

Dr. Petty Green Walker, Owensboro, aged 58, died suddenly May 26 from heart disease.

Dr. Samuel M. Hooper Tyler, Louisville, aged 68, died May 26.

Dr. Charles Farmer, Louisville, aged 55, died June 8.

Dr. Archibald Dixon, Henderson, aged 80, died June 9.

LOUISIANA

The local arrangements committee of the New Orleans meeting of the Louisiana State Medical Society appropriated

(Continued on page 36)

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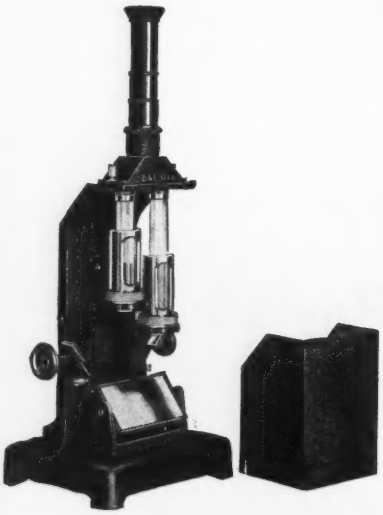

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(Continued from page 34)

$400 to the Walter Reed Memorial Fund. The by-laws were amended so that surplus money remaining in the annual arrangement fund each year should be given the Committee on Walter Reed Memorial up to the time that such fund reaches $2,000, after which it is to be returned to the general fund of the State Secretary.

A bill to arrest the propagation of the feeble-minded in state institutions by sterilization passed the Senate June 21 by a vote of 22 to 11.

Deaths

Dr. J. Algood Selby, Shreveport, aged 64, died June 1.
Dr. Charles F. Sauter, New Orleans, aged 53, died May 19.

MARYLAND

Johns Hopkins University Medical Department, through its Dean, Dr. Lewis H. Weed, announced the following appointments and promotions:

Dr. John W. McNee, Associate Professor of Medicine, University College Hospital Medical School, London, England, to be Associate Professor of Medicine; Dr. Bela Halpert, Assistant Professor to Prof. Otto Grosser, University of Prague, Czecho-Slovakia, to be Instructor in Anatomy; Dr. Henry M. Thomas, Jr., promoted to Associate Professor in Clinical Medicine; Dr. Bertram M. Bernheim to Associate Professor in Clinical Surgery; Dr. Richard S. Lyman to Associate Professor in Psychiatry; Dr. DeWitt B. Casler to Associate Professor in Clinical Gynecology; Francis H. Swett, Ph.D., to Associate Professor in Anatomy; William A. Perlzweig, Ph.D., to Associate Professor in Medicine; Dr. Paul G. Shipley to Associate Professor in Pediatrics. Dr. Wilburt C. Davison, Associate Professor of Pediatrics at the Johns Hopkins Medical School, has been appointed Assistant Dean of the Medical School, an office recently created which will permit Dr. Weed more time for research in anatomy. Dr. Davison received his degree from Johns Hopkins in 1917, after having studied at Princeton and at Oxford as a Rhodes scholar. He will continue to be Assistant Professor of Pediatrics.

The semi-annual meeting with the Governor of the Board of Mental Hygiene, Board of Welfare, and Boards of Managers of the State Hospitals for the Insane and Feebleminded was held recently at the Springfield State Hospital, Sykesville. The Clark Epileptic Colony, a group of several buildings for the treatment of epileptic patients at the Springfield State Hospital, was opened to patients.

The West Baltimore General Hospital, which contains 150 beds, was dedicated June 12-13.

The will of Frank P. Woodside provides $50,000 worth of Baltimore City 4 per cent stock for the Church Home and Infirmary, Baltimore. This is a memorial to the parents of Mr. Woodside and is to be used to provide a room for free patients.

Dr. Josiah S. Bowen, Baltimore, has been appointed County Health Officer to succeed Dr. Harry M. Slade, who has been appointed Medical Examiner of the Fire and Police Departments.

Dr. Lilian Welsh, Baltimore, Professor of Physiology and Hygiene at Gaucher College for thirty years, was given the honorary degree of LL.D. at the recent commencement on the occasion of her retirement from teaching.

Dr. Hugh H. Young, Johns Hopkins University Medical School, Baltimore, was elected President of the International Association of Urologists at the meeting recently held in Rome, Italy.

Dr. C. R. Truitt, Salisbury, was recently reappointed County Health Officer.

All the physicians, nurses and hospital employees of Johns Hopkins Hospital, Baltimore, were vaccinated in June, following the discovery of a case of smallpox in the negro ward.

Dr. Joseph E. Gately and Miss Catherine Neville Stack, both of Baltimore, were married June 4.

Deaths

Dr. Joseph Albert Seligman, Baltimore, aged 58, died June 13 from heart disease.

Dr. Georgiana DeVilbiss, Thurmont, aged 56, died June 3 from paralysis.

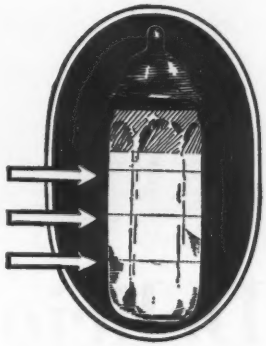
Dr. William H. H. Campbell, Owings Mills, aged 85, died May 29 at Brookline, Mass., from senility.

Dr. Joseph Charles Ohlendorf, Mount Rainier, aged 62, died suddenly June 11 from heart disease.

(Continued on page 38)

How much of the milk does the baby digest?

How much of the milk nourishment does the baby assimilate?



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In the research of the specific uses of gelatine in the dietary, conducted by Thomas B. Downey, Ph.D., Fellow at Mellon Institute, University of Pittsburgh, it was conclusively proved by feeding tests that 1% of plain gelatine dissolved and added to milk will increase by 23% the nourishment obtainable from that milk.

The following formula has proved the most efficacious:

Soak for ten minutes one level tablespoonful of Knox Sparkling Gelatine in ½ cup of cold milk taken from the baby's formula; cover while soaking; then place the cup in boiling water, stirring until gelatine is fully dissolved; add this dissolved gelatine to the quart of cold milk or regular formula.

It is, of course, important to use only the purest form of gelatine, of which the highest grade is Knox Sparkling Gelatine.

NOTE: Copies of this formula will be furnished, without charge, to physicians for use in practice, in any reasonable quantity.

The physician's attention is especially called to the importance of prescribing a pure gelatine, free from harmful acidity, artificial flavoring, and coloring. The highest standard of gelatine purity is always represented by

In addition to the family size packages of "Plain Sparkling" and "Sparkling Acidulated" (which latter contains a special envelope of lemon flavoring), Knox Sparkling Gelatine is put up in 1 and 5 pound cartons for special hospital use.

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Free from harmful acidity, artificial coloring, and synthetic flavoring.

Delicious *and* Nutritious

Quaker Puffed Wheat and Puffed Rice are *whole grains* that contain every vital food element, yet have the lure of a confection. Steam exploded to 8 times their natural size, with every food cell broken to make digestion easy.

Thus they provide grain energy in a form that both children and adults, ill or well, like and eat without urging—the flavor is richer than nutmeats.

Puffed Rice solves the breakfast problem. Puffed Wheat is the sleep-inviting bedtime dish. And in a bowl of half and half, either makes a most enticing luncheon.

Quaker Puffed Wheat
Quaker Puffed Rice

(Continued from page 36)

MISSISSIPPI

Dr. Henry S. Gully, Meridian, has been elected Superintendent of the Mattie Hersee Hospital, succeeding Dr. H. Samuel Hairston, resigned.

MISSOURI

The New Madrid County Medical Society met June 4. The following officers were elected: Dr. P. M. Mayfield, Portageville, re-elected President; Dr. C. S. Blackman, Parma, Vice-President; Dr. W. N. O'Bannon, New Madrid, Secretary-Treasurer.

The new Ensworth Hospital, St. Joseph, was recently dedicated. Drs. W. J. McGill and Jacob Geiger have resigned as directors, but Dr. Geiger still retains his post as President of the Hospital staff.

An ordinance is before the Board of Aldermen of St. Louis which, if adopted, will authorize the Hospital Commissioner to pay for blood to be used at the city institutions for transfusions when necessary to save the lives of patients. A fund of $500 is to be set aside for this purpose and $25 will be paid to each donor.

St. Luke's Hospital, St. Louis, is the beneficiary of a tract of land of 134 acres and buildings at Crescent, St. Louis County, through the gift of Mrs. George Warren Brown, St. Louis. This is to be used as a country department for patients needing quiet and seclusion and for those undergoing long periods of convalescence. It will be known as the George Warren Brown Farm and is a memorial to Mrs. Brown's husband. The donor has also provided a sufficient sum of money to care for the upkeep of the buildings and grounds.

The new roentgen ray and radium laboratories of the St. Louis Hospital were opened to private inspection and put in operation April 30.

The county support of the Sedalia Social Welfare Board was ordered withdrawn by the County Court, effective June 1. This action was taken to enable the County to take over the entire quota of $3,000 of the County for the Public Health Unit. The entire expense is approximately $10,000 annually. It is reported that the State will allow $4,500 of this total, the Red Cross $1,300, the Antituberculosis Society $300, and the Metropolitan Insurance Company $900.

The negro physicians in Kansas City have petitioned the Hospital and Health Board to appoint only negro physicians on the staff of the old City Hospital, which is used exclusively for negro patients.

The St. Mary's group of hospitals, comprising 600 beds, of which 200 are free, has by agreement become the University Hospital of the St. Louis University School of Medicine, the University having full control of the medical and educational activities, according to an announcement made by Dr. Loeb, Dean. The following have been appointed full-time physicians: Dr. Ralph A. Kinsella, Professor of Medicine and Director of the Department, formerly Associate Professor and Acting Head of the Medical Department of Washington University; Dr. Goronwy O. Broun, Associate Professor of Medicine, formerly Instructor in Medicine at Harvard University and Resident Physician at the Boston City Hospital; Dr. Charles H. Hitchcock, Assistant Professor of Medicine; Dr. Alfred P. Briggs, Instructor in Medicine; Dr. Octavio Garcia, Instructor in Medicine.

Dr. Steven Walter Ranson has been appointed Professor of Neuro-Anatomy and Director of the Department of Histology in Washington University Medical School.

Dr. Arthur I. Kendall, Chicago, has been appointed Director of the Department of Bacteriology and Hygiene at Washington University Medical School, St Louis.

Drs. Fred W. Bailey and William Engelbach, both of St. Louis University School of Medicine, and also on the staff of the St. John's Hospital, have resigned from the Faculty and Hospital.

Dr. Paul F. Stookey, Kansas City, has been appointed Health Commissioner, succeeding Dr. E. H. Bullock, resigned.

The following have been appointed consultants to the United States Veterans' Bureau: Dr. Sidney I. Schwab, Consultant in Neuro-Psychiatry, and Dr. L. H. Burlington, Consultant in Hospital Planning and Construction.

Dr. James W. Boger, Sedalia, has resigned as County Health Officer of Pettis County.

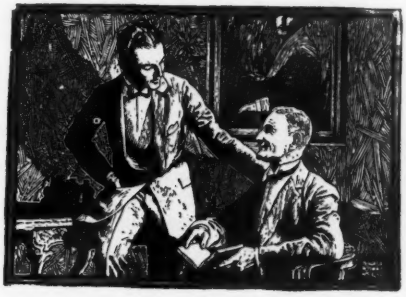
Dr. Paul V. Woolley has resigned as Chief of Police of Kansas City.

Dr. Charles H. Pope and Miss Iva P. Van Pelt, both of St. Louis, were married May 24.

Deaths

Dr. Richard M. Schmidt, Hannibal, aged 63, died May 22 at St. Elizabeth's Hospital, following a long illness.

(Continued on page 40)



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Smallpox

a present menace

Photo, courtesy Michigan Department of Health, 1924

Smallpox is again the loathsome, disfiguring, and oft-times fatal disease it was years ago, when Jenner first advocated vaccination.

The disease may assume a highly virulent and hemorrhagic form at any time, as witness the case here pictured, which occurred in Michigan as recently as June, 1924.

Vaccination Urgent

A large percentage of the American population is unvaccinated, therefore, unprotected against smallpox, but the increasing incidence and virulence of the disease in this country makes it a public duty to vaccinate ***now*** all persons not recently vaccinated.

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ACTIVE—PURE—DEPENDABLE

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THE PIONEER BIOLOGICAL LABORATORIES

(Continued from page 38)

Dr. Alexander Read Mitchell, Kansas City, aged 53, died June 7.

Dr. Charles W. Williamson, Poplar Bluff, aged 62, died suddenly June 3 at St. Louis from heart disease.

Dr. D. S. Talbot, Appleton City, aged 77, died April 16 from heart disease.

Dr. Thomas Renshaw Appleby, Springfield, aged 77, died May 19 following a long illness.

Dr. John N. Nicks, Powe, aged 74, died June 9 from bronchopneumonia.

Dr. Christopher Columbus Morris, St. Louis, aged 65, died June 9 at Battle Creek, Mich.

Dr. Robert Loura Mount, Polo, aged 56, died June 11 at the Christian Church Hospital, Kansas City.

NORTH CAROLINA

Avery County Medical Society has elected Dr. E. H. Sloop, President; Dr. W. B. Burleson, Secretary.

Wayne County established a record in results in public health work for the quarter which recently ended. It earned $3.73 for each dollar expended during the previous three months. Sampson County previously held the record with $2.57 earned for each dollar expended. The State has thirty-two whole-time county health officers.

The North Carolina Tuberculosis Association has opened offices in Southern Pines with Dr. L. B. McBrayer, Managing Director, in charge. A recent meeting of the Executive Committee authorized the appropriation of $3333 to some county in the State willing to assume the remainder of the required expense to be used in a child health demonstration.

Dr. L. B. McBrayer, Sanatorium, was recently elected Chairman of the Board of Directors of the North Carolina State Odd Fellows' Orphanage. He has been a member of the Board for several years.

The new maternity ward at the Rex Hospital, Raleigh,

(Continued on page 42)

QUALITY *First*—SERVICE *Always*

Account for beneficial clinical results physicians obtain by prescribing

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CHEPLIN'S B. ACIDOPHILUS MILK will be found of distinct value in the treatment of intestinal toxemias. It provides an effective means of overcoming putrefactive processes in the intestines and regulating bowel movements.

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Clinical improvement is manifested by relieving co-existing toxic symptoms of headache, fatigue and intestinal gas.

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PRICE—Six 14-oz. bottles, $2.00; twelve 14-oz. bottles, $3.75, plus delivery charges.

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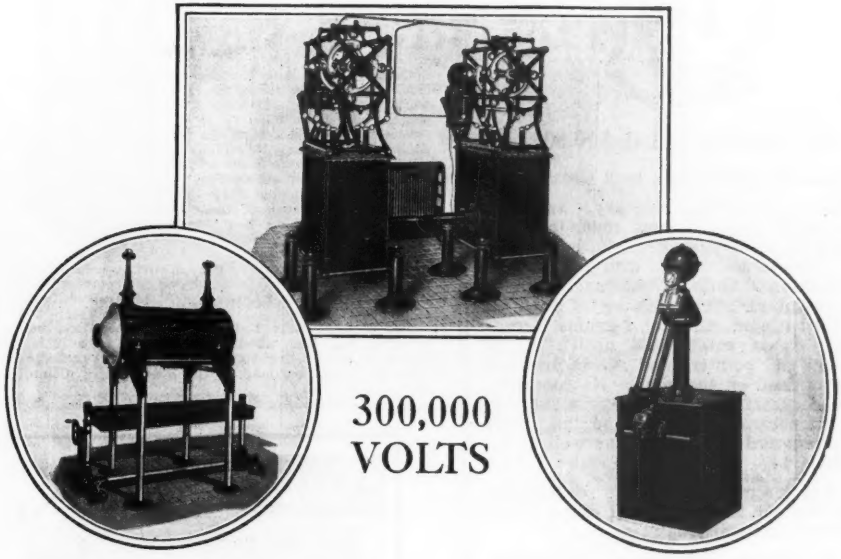

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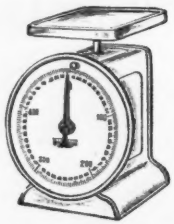

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Sturdily constructed, sanitary, accurate, can be readily carried from room to room, as platform and post slips in bottom of scale. Easy to use. Place dish on platform and rotate dial until "0" is exactly under end of pointer. Place helping of food on plate until proper number of grams is registered. Again rotate dial until "0" is under end of pointer, and weigh another portion of food on the plate. No computation or deduction for tare. Porcelain top. White enamel washable body and dial. Used by hospitals and sanitariums, as well as by individuals.

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Surgical Instruments, Hospital, X-Ray and Laboratory Supplies

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(Continued from page 40)

was recently opened. The ward will care for sixteen patients. The addition also consists of a nursery, eight private rooms, one two-bed ward, and one six-bed ward.

It is reported that the Comptroller of the Treasury has ruled that about thirty physicians on duty at the Veterans' Bureau Hospital, Oteen, are not entitled to the allowance for quarters. This will mean a reduction in salary of $60 a month for Lieutenants and $80 a month for Captains, or moving back to hospital quarters erected for temporary occupancy during the war, and which are undesirable.

Dr. Keenan Casteen, Mayodan, and Miss Pearl Roberts, Charlotte, were married May 31.

Deaths

Dr. Floyd Caldwell Shugart, High Point, aged 33, died May 30 from pneumonia.

OKLAHOMA

Cushing Municipal Hospital has been placed under the control of one physician, the city officials feeling this would work for greater efficiency and satisfaction, both professionally and financially.

The Freshman Class at the Oklahoma University Medical School for the year 1924-1925 is already filled. No further applications for enrollment will be received. Only Oklahoma students have been considered. A new medical school building will be completed early in 1925, when it is expected that a larger number of students can be accommodated.

Miss Emma Fuchs has been appointed Dietitian of the State University Hospital to succeed Miss Grace Bayles, resigned.

Mrs. Ada Reitz Crocker, formerly connected with the University of Iowa Hospital, has been appointed Director of the State School of Nursing, State University Hospital, Oklahoma City.

The Medical Arts Building, Oklahoma City, being constructed, has been almost fully rented, and it is contemplated to add another story to the building, according to Dr. John S. Pine, Chairman of the Stockholders' Committee.

(Continued on page 44)

Neosalvarsan

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"The Dependable Original"

Made in the United States in strict conformity with Ehrlich's processes and formulas. Government tested.

Our obligation of responsible helpfulness towards practitioner and patient is being fulfilled through the medium of lowered prices of Neosalvarsan possible by quantity production.

I.	0.15 gram	$.60 per ampule
II.	0.3 "	.65 " "
III.	0.45 "	.70 " "
IV.	0.6 "	.80 " "
V.	0.75 "	.90 " "
VI.	0.9 "	1.00 " "

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Neosalvarsan, the dependable original, is unsurpassed in low toxicity and is unequalled in therapeutic effectiveness. These facts have been demonstrated through extensive use during the past thirteen years and constitute a unique record.

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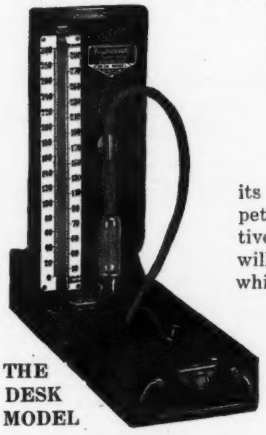

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DESK MODEL (300 mm. calibration)	$32.00
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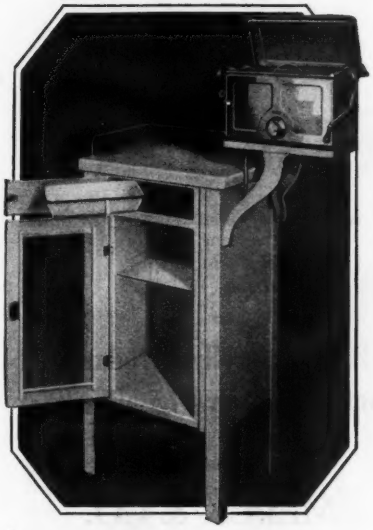

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SEE IT—TODAY—AT YOUR DEALERS OR SEND FOR FOLDER "CLINIC MODEL STERILIZERS"

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632 Harper Ave. Detroit, Michigan

(Continued from page 42)

Dr. James H. Cash, Stillwater, is acting Payne County Health Officer since the death of Dr. J. B. Murphy, May 19.

Dr. Shade D. Neely has been appointed Roentgenologist for the U. S. Veterans' Hospital No. 90, Muskogee.

Dr. Charles W. Tedrowe, Woodward, has been elected Grand Commander of Knights Templar.

Deaths

Dr. William Nairn, Alluwe, aged 75, died May 18 in a hospital at Oklahoma City from cerebral hemorrhage.

Dr. Joseph M. Stephens, Hastings, aged 52, died June 20.

SOUTH CAROLINA

The South Carolina Hospital Association held its annual meeting in Orangeburg April 15. Dr. C. Fred Williams, Superintendent State Hospital, Columbia, was elected President; Mr. W. Julian Clark, Superintendent Columbia Hospital, Columbia, was elected Secretary-Treasurer.

The Ridge Medical Association met May 19. Dr. James Crosson, Leesville, was elected President; Dr. Karl L. Able, Batesburg, Vice-President; Dr. E. C. Ridgell, Batesbury, Secretary-Treasurer.

The Wallace-Thompson Hospital, Union, on June 2 was sold by auction to a syndicate which will incorporate a company to continue to operate the institution.

The Freshman Class at the Medical College of the State of South Carolina is already filled, it is reported.

A new county hospital to cost $40,000 will be erected at Newberry.

The Board of Health, Charleston, at a recent meeting, elected Dr. William H. Price, Chief Food Inspector for the City, and Jack C. Norris Assistant City Bacteriologist.

The Brewer Hospital for Negroes, Greenwood, recently completed at a cost of $30,000, was dedicated May 25. The institution was made possible by an appropriation of $15,000 by the American Missionary Association and the remainder was subscribed.

Dr. Jean B. LaBorde, Columbia, has resigned as City Health Officer.

(Continued on page 46)

"Oats and Milk"

Do you approve this Breakfast Dish?

The proportion of calories, proteins and calcium is greater in oats than in any other cereal, authorities say. And the flavor of oats richer in Quaker, according to culinary experts.

Quaker Oats are flaked from the finest, plumpest grains. We get but ten pounds to a bushel — that's the way we get that richer, finer flavor.

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Standard full size and weight packages—
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Quick Quaker

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The kind you have always known

For dependable results

Digitan Tincture

Equivalent volume for volume to fully potent tincture of digitalis.

Is Physiologically Standardized
Insures Uniform Digitalis Effect

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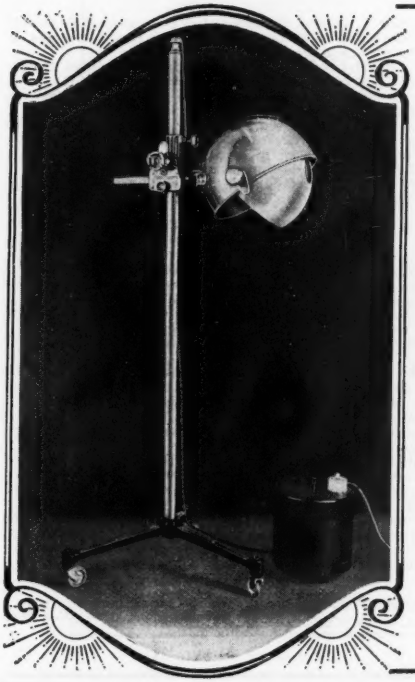

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Request booklet 38

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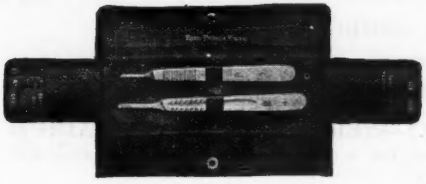

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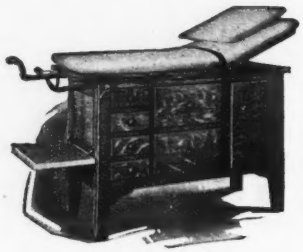

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(Continued from page 44)

Dr. James A. Hayne, Columbia, has been elected President of the Association of State and Provincial Health Officers of North America and Canada.

Dr. F. H. McLeod, Florence, has been appointed Chairman of the Special Committee to appear before the Governor and the Attorney-General to call their attention to the necessity for the prosecution of illegal practitioners.

Dr. E. A. Hines, Seneca, has received a commission as Major in the Medical Reserve Corps of the U. S. Army.

Dr. Charles H. Pate, Bishopville, has been appointed Health Officer of Henderson County and Hendersonville.

Dr. M. H. Wyman, Columbia, has been appointed Chairman of the Committee on Legislation for the coming year.

TENNESSEE

A contagious disease hospital building will be erected at Baroness Erlanger Hospital, Chattanooga. It will be an entirely separate institution from the main building.

The doctors of Knox County have organized a Doctors' Club to be located in the Doctors' Building.

Dr. Richard McIlwane has been re-elected Medical Inspector of the City schools of Knoxville.

Dr. W. S. Nichols succeeds Dr. J. R. Harris as Director of the Montgomery County Health Unit. Dr. Harris has gone to Memphis and will be connected with the Willis C. Campbell Clinic.

Dr. George K. Carpenter has succeeded Dr. W. B. Sugg as Resident Physician of the Nashville General Hospital.

Dr. Marvin F. Haygood, formerly Director of Municipal and Rural Sanitation for the State Health Commission of Georgia, has been appointed full-time Health Officer of Knoxville.

Dr. Herman Spitz, Nashville, at the recent meeting of the American Association of Clinical Pathologists, held in Rochester, Minn., was elected Chairman of the Executive Committee.

Deaths

Dr. Albert E. Lea, Athens, died the latter part of April.

Dr. C. L. Hackworth, South Pittsburg, aged 54, died May 23 at a sanatorium in Chattanooga.

(Continued on page 48)

Laboratories of

Drs. Bunce, Landham and Klugh

ATLANTA, GEORGIA

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These laboratories are equipped for making every test of clinical value in the diagnostic study of medical and surgical cases. Only standardized methods and technique are used.

In addition to the diagnostic study of cases there are adequate facilities for the x-ray and radium treatment of conditions in which these forms of treatment are indicated.

Fee lists and containers for pathological specimens and information in reference to x-ray and radium work furnished upon request.

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POWDERED WHOLE MILK

	The	Liquid as
BUTTERFAT	26.00%	3.33%
CASEIN	21.38%	2.75%
ALBUMIN	3.46%	.45%
LACTOSE	38.00%	4.33%
ASH	3.76%	.69%
WATER	4.50%	88.27%
CALORIES (per ounce)	149	18.

4½ Ounces to a quart of water

KLIM is completely soluble in water of any temperature

When Used in Infant Feeding

Reconstituted KLIM at normal strength has the same analysis and caloric value as natural whole cows milk and is subject to the same modifications when used in infant feeding

Recognizing the importance of scientific control, all contact with the laity is predicated on the policy that KLIM may be used in infant feeding only according to a physician's formula. If not available in any locality we will supply any pharmacy upon a physician's request.

KLIM is not merely a milk for infants

KLIM is whole milk with 1⅝% instead of 87½% moisture. By the addition of water it is restored to liquid milk with the normal caloric value and analysis.

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Its increased assimilability makes it the ideal milk for the growing child. The transition from the baby's feeding to the child's ration is merely the removal of the last slight modification.

Its price permits its general use in the home, as a pure milk of known origin, fully guaranteed by the largest manufacturer of powdered or dried milk in the world.

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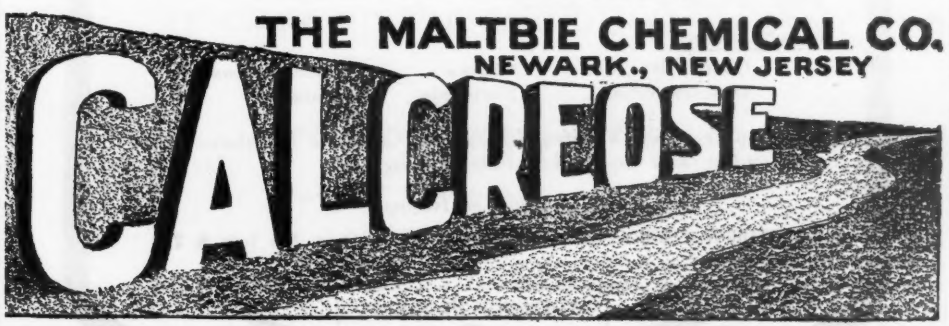

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29-31 West Sixth Street CINCINNATI, OHIO

(Continued from page 46)

Dr. Archibald Cruickshanks, Fayetteville, aged 54, died in May from chronic nephritis.

Dr. F. G. Hudson, Camden, aged 89, died June 9.

Dr. Augustine Claiborne Somervill, Mason, aged 88, died May 17 from senility.

Dr. James A. North, Franklin, aged 86, died May 31.

TEXAS

The Rio Grande Public Health Society was organized in Harlingen May 30. The following officers were elected: Dr. B. L. Cole, Brownsville, President; Dr. G. A. McBride, Harlingen, Vice-President; Dr. J. R. Mahone, Pharr, Secretary-Treasurer.

The Texas Pharmaceutical Association has elected W. H. Whisenant, San Antonio, President; A. W. Griffith, Austin, and William Willman, Brownsville, Vice-Presidents; W. D. Adams, Forney, re-elected Secretary-Treasurer.

The State Graduate Nurses' Association met in Dallas June 11-13. The following officers were elected: Miss Mary Grigsby, Waco, President; Misses Ellen Louise Brient, San Antonio, Arline McDonald, Temple, and Grace Gray, Galveston, Vice-Presidents; Miss A. Louise Dietrich, El Paso, Secretary-Treasurer.

The Coudcroft Baby Sanatorium, El Paso, has been opened. Miss Mina W. Jadwin is Superintendent.

The Johnson-Beall Hospital, Fort Worth, has changed its name to Southwestern Hospital.

A contract has been let for a $50,000 county hospital at Seymour. Work will begin on the hospital at once, it is announced.

A new sanatorium will be erected at Lamesa. Dr. C. J. Loveless is owner.

Dr. James Mackins was recently appointed head of the Bureau of Communicable Diseases of the State Board of Health.

Dr. G. Burton Fain announces his change of address from Blackwell to Sweetwater.

Dr. G. A. McBride, Harlingen, has been appointed City Health Officer.

(Continued on page 50)

Important Advance in Sedative Therapy

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ELIXIR OF LUMINAL

(¼ gr. to teaspoonful)

Small sedative doses of Luminal are extensively used in neuroses other than epilepsy and in organic affections. Elixir of Luminal, a very palatable, stable solution (12 oz. bottles), and Tablets of Luminal, ¼ and ½ grain (bottles of 100), are available for this purpose.

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Also Hyperthyroidism, Vomiting of Pregnancy, Climacteric Disturbances, Pre- and Post-Operative Cases and for Relief of Cough.

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And in reference to dangerous bacteria in liquid milk, he further writes:

" Bacteria grows with amazing rapidity in milk."

" In Raw Market Milk as many as one billion and a quarter germs has been found in a single teaspoonful."

"Milk under the guise of its innocent white color often hides the presence of dangerous germs."

"Milk must be produced by healthy cows ."

"Milk must be clean."

"SAFE MILK saves Babies and diminishes the prevalence of Tuberculosis, Typhoid, Diphtheria, Septic Sore Throat and other diseases."

AVOID ALL DANGERS—USE "DRYCO" A SAFE AND PURE DRIED MILK HIGHLY NUTRITIOUS, EASILY DIGESTED, CONTAINING ALL THE VITAMINS UNCHANGED, STABLE AND FREE FROM ALL HARMFUL BACTERIA.

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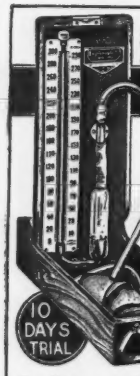

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Address.....

(Continued from page 48)

Dr. George M. Jones and Mrs. Annie Joe Martin, both of Smithville, were married in June.

Deaths

Dr. Travis Raybourne Black, Clarksville, aged 51, died February 28.

Dr. Raoul Rene Daniel Cline, Galveston, aged 56, died May 20 from cerebral hemorrhage.

Dr. Ambrose Burdett Crain, Belton, aged 40, died June 3.

VIRGINIA

The Piedmont Medical Society, at its semi-annual meeting in Charlottesville May 31, elected Dr. J. F. Thaxton, Tye River, President; Dr. J. Fulton Williams, Charlottesville, and Dr. W. C. Mason, Gordonsville, Vice-Presidents; Dr. Lewis Holladay, Orange, re-elected Secretary-Treasurer.

The Graduate Nurses' Association of Virginia held their meeting May 27-29. Miss Agnes Randolph was elected President; Misses L. L. Odom, Norfolk, Hattie V. Norris, Roanoke, and Evelyn Hill, Harrisonburg, Vice-Presidents; Miss Alice Dugger, Richmond, Secretary; Miss Florence Bishop, Staunton, Treasurer.

Walter Reed Medical Society held its annual meeting in Newport News May 14-15. Dr. George W. Brown, Williamsburg, was elected President; Drs. G. W. McAllister, Hampton, M. B. Beecroft, Newport News, L. C. Brock, Smithfield, C. B. Courtney, Newport News, and J. J. Cullinan, National Soldiers' Home, Vice-Presidents; Dr. L. E. Stubbs, Newport News, re-elected Secretary; Dr. J. E. Marable, Newport News, Treasurer.

The Medical Association of the Valley of Virginia held its semi-annual meeting in Harrisonburg May 29. The next meeting will be held in Staunton at the same time of the Medical Society of Virginia, October 14-17, instead of in Clifton Forge.

Norfolk County Medical Society has elected Dr. R. L. Payne, Norfolk, President; Dr. Stanley H. Graves, Norfolk, Vice-President; Dr. Lockburn Scott, Norfolk, re-elected Secretary-Treasurer.

The Medical Society of Virginia, Maryland and the District of Columbia held its regular semi-annual meeting in Alexandria May 21. Dr. Howard Fletcher, Warrenton, was elected President; Dr. George T. Klipstein, Alexandria, and Dr. Thomas M. Foley, Washington, D. C., Vice-Presidents; Dr. William T. Davis, Washington, D. C., Recording Secretary; Dr. Joseph D. Rogers, Washington, D. C., Corresponding Secretary; Dr. Robert Scott Lamb, Washington, D. C., Treasurer.

Danville General Hospital, Danville, will construct a new building with the $250,000 bequeathed the institution by the late John E. Hughes. A site has been purchased and building plans are being drawn up. It is proposed to include in the hospital plans quarters for the City Health Department.

The sterilization law for mental defectives in state institutions became effective in June.

Dr. J. Thomson Booth, Ashland, at the organization meeting of the Camp of Sons of Veterans, held at Ashland, was elected Surgeon for the organization.

Dr. B. B. Bagby, Health Officer of Henrico County, has been appointed Acting Health Officer of Richmond, filling

(Continued on page 52)

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PHYSICIANS often find that patients who wear leather heels are denied the benefits they would obtain from walking, the best of outdoor exercises, but for the early and extreme fatigue produced.

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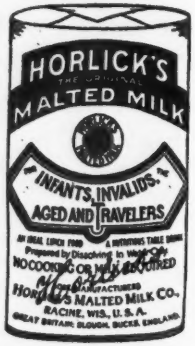

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Prescribed extensively because of its proved nutrient advantages.

(Continued from page 50)

the vacancy caused by the resignation of Dr. C. C. Hudson, who accepted the position as Health Officer of Greensboro and Guilford County, North Carolina.

Dr. Carrington Williams, Richmond, was recently elected a member of the Board of Directors of the Morris Plan Bank, Richmond.

Dr. S. C. Draper, Norfolk, who recently accepted a position with the Relief and Pension Department of the Norfolk and Western Railway Company, has been transferred to Bluefield, W. Va.

The Virginia Polytechnic Institute Alumni Association, at its annual meeting held in May, re-elected Dr. Lawrence T. Price President of the Richmond Chapter.

Dr. William P. Bittinger has accepted the position of Resident Interne at Pine Camp, Richmond.

Dr. George P. Hamner, Lynchburg, has been elected President of the Piedmont Field and Stream Club.

A law forbidding the intermarriage of negroes and Caucasians went into effect June 15.

Dr. Sidney B. Trattner and Miss Leah Whitlock Binswanger, both of Richmond, were married May 5.

Dr. Richard H. Meade, Jr., Richmond, and Miss Mazie G. Frazier, Chestnut Hill, were married June 14.

Dr. Hunter Holmes McGuire and Miss Catharine Skelton Bemiss, both of Richmond, were married May 24.

Deaths

Dr. Robert Llewellyn Powell, Belmont, aged 38, died May 17.

Dr. Joseph Vandeventer, Leesburg, aged 77, died May 17 from pneumonia.

Dr. Henry Harrison Jones, aged 81, formerly of Doe Hill, died at the home of his daughter in Mebane, N. C., May 11, after a short attack of acute indigestion.

WEST VIRGINIA

Dr. Marshall W. Sinclair, formerly connected with the Anderson County Hospital, Anderson, S. C., has accepted the position of Pathologist with St. Luke's Hospital, Bluefield.

Deaths

Dr. Eph Lockwood, Fort Gay, aged 56, died suddenly May 15.

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From time immemorial, leavening gas has been the "touch" which made the paste of flour and water a digestible food—the staff of life. A flat and soggy loaf or biscuit is an unleavened food. So it is that leavening agents such as yeast or baking powder are employed.

To insure to the American housewife complete leavening of her biscuits, cakes, muffins, etc., which is so important to perfect digestion, the pure food authorities found it wise to require a certain standard of leavening strength in baking powder.

To maintain this guaranty of digestibility—to insure minimum deterioration of leavening strength, baking powder must be packed in tin. This prevents absorption of atmospheric moisture. Dampness produces premature reaction between acid and soda—results in loss of leavening gas.

The food official, or you, as a physician, would properly condemn baking powder if packed in porous sacks.

But what about self rising flour? It comes to the southern housewife from remote northern mills packed in bags. What happens to this combination of baking powder material and flour?

Chemical analysis shows that much of it has lost its leavening strength before it reaches the consumer.

Breadstuffs made with such self rising flours cannot raise properly—they come to the table heavy, flat and soggy. You physicians are the best judges of the digestibility.

Why don't the pure food officials demand that self-rising flours contain 0.5% leavening gas, the equivalent to the 12% required of baking powder?

Calumet Baking Powder is scientifically and legally correct—the last spoonful is as pure and sure as the first. Packed in tin—keeps the strength in.

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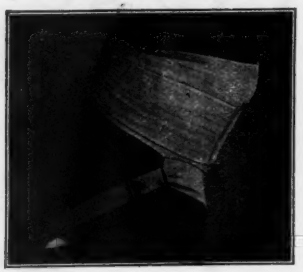

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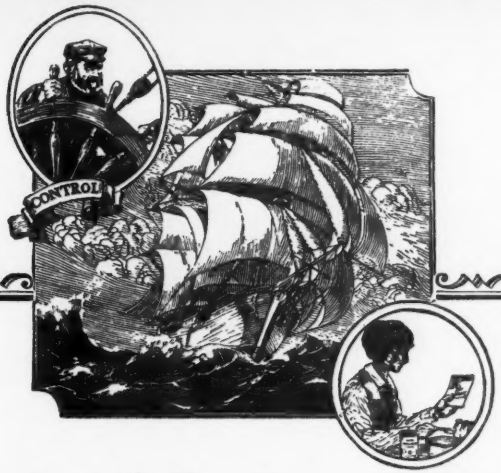

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When the doctor prescribes a feeding formula on his own prescription blank the mother obeys his instructions, and the baby is responsive to his diet. Mead's Infant Diet Materials have no directions on the package to interfere with the doctor's prescription—the *doctor controls* his infant feeding *throughout the entire feeding period.*

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Its freedom from corrosive effect makes it acceptable for continued courses of intramuscular or intravenous injection in the treatment of syphilis. It is not precipitated by blood serum and it may be used repeatedly by the intravenous route without the likelihood of its causing obliteration of the vein. As many as twenty-seven intravenous injections have been given in a section of the vein less than one-half inch long without injury to its wall or apparent narrowing of its lumen.

It is eliminated for the most part through the intestines as mercury sulphide and should not irritate the kidney epithelium.

The average intramuscular dose is 0.05 gram increased to 0.1 gram; the average intravenous dose is 0.1 gram, and if no unusual susceptibility to mercury develops, may be increased to 0.2 gram.

Put up in liquid form six 10-cc ampoules to the box, 0.1 gram Mercurosal in each ampoule; also in powder, 12 vials to the box, 0.05 gram or 0.1 gram Mercurosal in each vial.

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